The City and Borough of Juneau

All-Hazards Mitigation Plan 2004

FINAL

December 7, 2004

The City and Borough of Juneau

All-Hazards Mitigation Plan

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Section 1: Planning Process and Methodology

The City and Borough of Juneau (CBJ) All-Hazards Mitigation Plan includes information to assist city agencies and residents with planning to avoid potential future disaster losses. The plan provides information on hazards that affect Juneau, descriptions of past disasters, and lists activities that may help the CBJ prevent disaster losses. The plan was developed to help the CBJ make decisions regarding natural hazards that affect Juneau. The CBJ formally adopted the plan on November 22, 2004. A copy of the adoption resolution is provided in Appendix B.

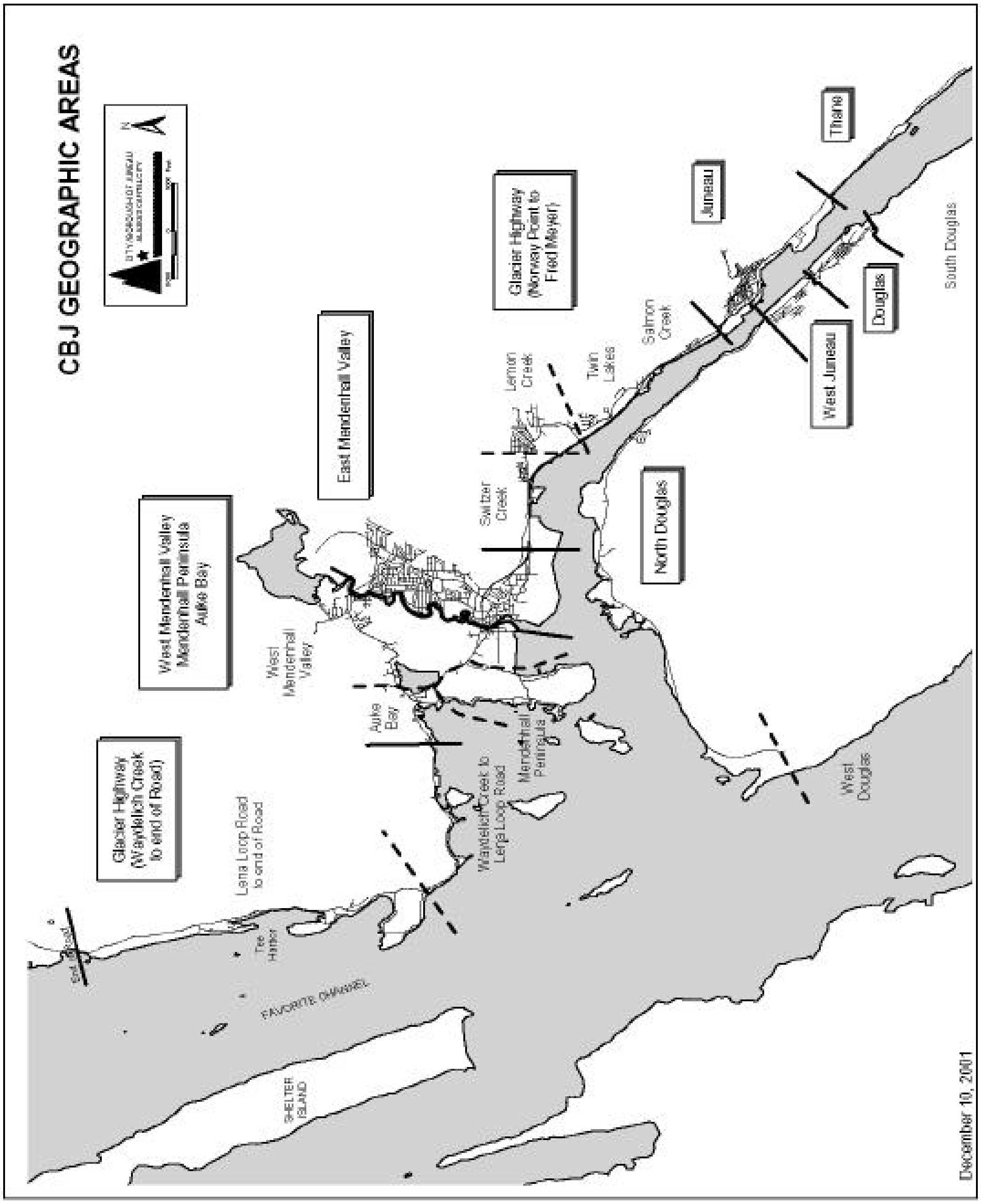
Plan Development

Plan Scope

Juneau encompasses a very large geographical area, however the CBJ itself is the sole governing body for any and all neighborhoods, areas, and settlements that lie within the Borough, including Douglas, Thane, Auke Bay, the Mendenhall Valley, Glacier Highway, West Juneau, and North Douglas (see Map 1 on page 2). The following table lists the developed areas involved in the development of the plan. An "N/A" indicates that the area does not have the capability or mechanism to complete the requirement. Areas and neighborhoods that do not have a governing body are not able to formally adopt the plan. *Due to Juneau's geographic size, the following areas are being classified as jurisdictions for the purposes of this plan at the request of the State of Alaska, although for risk assessments the entire CBJ is treated as one jurisdiction:*

Table 1 Jurisdictions Involved in Planning Effort

	Juneau	Douglas	Thane	Auke Bay	Mendenhall Valley	Glacier Highway	North Douglas	West Juneau
Did the community participate in the planning process?	Y	Y	Y	Y	Y	Y	Y	Y
Has the local governing body adopted the plan?	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Is supporting documentation (i.e., a resolution) included in the plan?	Y	N/A	N/A	N/A	N/A	N/A	N/A	N/A
How did the communities participate in the planning process?	Each community had the opportunity to participate in the planning process and were invited to do so via Public Service Announcements, e-mails, public meetings, and the Internet.							



Map 1 CBJ Geographical Areas

Project Staff

The plan was designed and written beginning in the spring of 2003 by Jill Missal of CBJ Emergency Management with contributions from Chris Maier from the Juneau Office of the National Weather Service. The State of Alaska Division of Emergency Services (ADES) contributed significant portions of the hazard descriptions from its own Mitigation Plan and provided valuable input during draft reviews. The project was overseen by the Capital City Emergency Planning Committee(CCEPC). Information from other sources is credited in the plan, and a list of CCEPC members and plan participants can be found in Appendix A: Public Involvement.

The CBJ contracted a hazard mitigation consultant, URS Corporation, to complete the vulnerability assessments for avalanche, landslide, and downtown fire hazards, as well as public meeting facilitation, capability assessments, preparation of prioritization criteria, mitigation prioritization, and cost/benefit analysis.

Plan Coordination

The CBJ has established the CCEPC as an all-hazards planning committee. Duties and activities of the CCEPC include: advising the City Manager on emergency management issues and maintaining the emergency response plan for all emergencies that may potentially affect the Juneau area. The CCEPC is responsible for undertaking the formal review process of the Mitigation Plan. CCEPC members will evaluate the effectiveness of the plan, discuss implementation of mitigation strategies, and suggest new mitigation strategies to reduce losses from hazards.

Plan Research

The plan was developed utilizing existing CBJ plans and studies as well as outside information and research. Outside sources are credited in footnotes.

The following CBJ plans were used as references while developing the Mitigation Plan:

- Comprehensive Plan of the City and Borough of Juneau, 1996
- City Center Transportation Improvement Plan, 1997
- City and Borough of Juneau Emergency Operations Plan, 2003
- Geophysical Hazards Investigation for the City and Borough of Juneau, 1972
- Avalanche Risk Analysis and Mitigation Recommendations for the Proposed Alaska-Juneau Project, 1989
- City and Borough of Juneau Hazard Analysis, 2001
- Title 49, Land Use Ordinances, 2001
- Juneau Area Mass-Wasting and Snow Avalanche Hazard Analysis, 1992
- City and Borough of Juneau Transportation Vision, 2000
- Flood Insurance Study, 1990
- City and Borough of Juneau Land Management Plan, 1999

Public Involvement

The CBJ held two public meetings to gather opinions and ideas for the Plan. One meeting was held during development of the Plan and the other was held after completion of the draft. An additional opportunity for public comment was during the CBJ plan adoption meeting. Public Involvement is documented in Appendix A: Public Involvement.

During the first community meeting, participants identified hazards that threaten Juneau and chose three hazards about which they were the most concerned: avalanche, landslide, and downtown fire. These three hazards were judged to present a risk of extremely damaging losses to the CBJ as well as a relatively high probability of occurrence. The plan currently contains complete hazard identification, risk assessment, and mitigation strategies for avalanches, landslides, and downtown fire. The second meeting gave the community further opportunity to submit their comments on the draft plan, as well as provide their thoughts on prioritizing mitigation actions and suggestions for alternatives.

The public has the opportunity to provide further comments on the draft plan through a variety of forums, including public meetings, e-mail, and the Internet. Copies of the plan will be available at City Hall for public perusal. In addition, the plan and any proposed changes will be posted on the CBJ Emergency Management Web site at: http://www.juneau.org/emergency. This site provides contact information to which residents can direct their comments, concerns and ideas.

Plan Implementation

The CBJ Assembly will be responsible for adopting the CBJ All-Hazards Mitigation Plan and all future updates or changes. This governing body has the authority to promote sound public policy regarding hazards. The Hazards Mitigation Plan will be assimilated into other CBJ plans and documents as they come up for review according to each plans' review schedule:

Table 2 CBJ Plans

Document	Review Schedule	Next Review
Comprehensive Plan	Biannual	2005
Capital Improvement Projects	Annual	2005
CBJ Land Management Plan	Annual	2004
Emergency Operations Plan	Annual	2004

Continuing Review Process

The CCEPC will evaluate the CBJ All-Hazards Mitigation Plan on an annual basis to determine the effectiveness of programs and to reflect changes in land development, status, or other situations that make changes to the plan necessary. The committee will review the mitigation action items to determine their relevance to changing situations in the city, as well as changes in state or federal policy, and to ensure that mitigation continues to address current and expected conditions. The committee will review the hazard analysis information to determine if this information should be updated and/or modified, given any new available data or changes in status.

Continued Plan Development

The plan will continue to be developed as resources become available. Additional hazards not currently covered in the plan, including technological, manmade and natural hazards, will be added at a rate of approximately one chapter per year. Vulnerability assessments not included in this plan will be added to existing hazard chapters at the rate of approximately one per year. CBJ Emergency Management staff will be responsible for updating and maintaining the plan by adding additional hazards and completing vulnerability assessments for existing hazard chapters.

The following table lists the schedule for completion of these tasks, provided that funds are available to do so:

Table 3 Continued Plan Development

Hazard	Status	Hazard Identification Completion Date	Vulnerability Assessment Completion Date
Avalanche	Complete	2004	2004
Landslide	Complete	2004	2004
Downtown Fire	Complete	2004	2004
Earthquake	In progress	2004	2005
Severe Weather	In progress	2004	2006
Air Transportation	In progress	2004	2007
Floods	In progress	2004	2008
Volcano	In progress	2004	2009
Wildland Fire	In progress	2004	2010
Tsunami	In progress	2004	2011
Power Grid Failure	To be added	2005	2012
Public Health Crisis	To be added	2006	2013

Risk Assessment Methodology

The goal of mitigation is to reduce the future impacts of a hazard including loss of life, property damage, disruption to local and regional economies, environmental damage and disruption, and the amount of public and private funds spent to assist with recovery.

Mitigation efforts begin with a comprehensive risk assessment. A risk assessment measures the potential loss from a disaster event caused by an existing hazard by evaluating the vulnerability of buildings, infrastructure, and people. It identifies the characteristics and potential consequences of hazards and their impact on community assets.

A risk assessment typically consists of three components; hazards identification, vulnerability assessment and risk analysis.

1. *Hazards Identification* - The first step in conducting a risk assessment is to identify and profile hazards and their possible effects on the jurisdiction. This information can be found in Section 3: Hazards.

2. *Vulnerability Assessment* – Step two is to identify the jurisdiction's vulnerability; the people and property that are likely to be affected. It includes everyone who enters the jurisdiction including employees, commuters, shoppers, tourists, and others. Populations with special needs such as children, the elderly, and the disabled must be considered; as must facilities such as hospitals and prisons because of their additional vulnerability to hazards. Areas with large non-English-speaking populations are also at risk because safety messages delivered only in English may not reach such populations.

   Inventorying the jurisdiction's assets to determine the number of buildings, their value, and population in hazard areas can also help determine vulnerability. A jurisdiction with many high-value buildings in a high-hazard zone will be extremely vulnerable to financial devastation brought on by a disaster event.

Identifying hazard prone critical facilities is vital because they are necessary during response and recovery phases. Critical facilities include:

- Essential facilities which are necessary for the health and welfare of an area and are essential during response to a disaster, including hospitals, fire stations, police stations, and other emergency facilities;
- Transportation systems such as highways, airways and waterways;
- Utilities; water treatment plants, communications systems, power facilities;
- High potential loss facilities such as dams or military installations; and
- Hazardous materials facilities.

Other items to identify include economic elements, areas that require special considerations, historic, cultural and natural resource areas and other jurisdiction-determined important facilities.

3. *Risk Analysis* – The next step is to calculate the potential losses to determine which hazard will have the greatest impact on the jurisdiction. Hazards should be considered in terms of their frequency of occurrence and potential impact on the jurisdiction. For instance, a possible hazard may pose a devastating impact on a community but have an extremely low likelihood of occurrence; such a hazard must take lower priority than a hazard with only moderate impact but a very high likelihood of occurrence.

Additionally, the risk analysis must utilize a multi-hazard approach to mitigation. One such approach might be through a composite loss map showing areas that are vulnerable to multiple hazards. For example, there might be several schools exposed to one hazard but one school may be exposed to four different hazards. A multi-hazard approach will identify such high-risk areas and indicate where mitigation efforts should be concentrated. Currently there are insufficient funds and data with which to conduct an accurate risk analysis for all the hazards affecting the CBJ. However, risk analysis information will be added as it is completed.

Vulnerability Assessment Methodology

The purpose of a vulnerability assessment is to identify the assets of a community that are susceptible to damage should a hazard incident occur. It describes the extent of the potentially affected area, the population that would be affected, and the property that may be damaged.

Population data by parcel is not currently available for the CBJ. For the purposes of this project, data that was provided by the CBJ Planning Department was interpolated from the CBJ Tax Assessors Database (10-2003), CBJ Estimated Population per TAZ block (06-2002) and CBJ 2001 Census by housing unit data to create population estimates by parcel (for specific residential housing types) for the immediate project area (just North of White Subdivision through downtown Juneau to just Southwest of Mt. Roberts Street off Thane Road). This data has been entered into GIS and is displayed in Map 2 on page 11.

Population information is not currently available to assist in identifying the number of persons employed by parcel. For the purposes of this project, it is assumed that approximately 16,700 people are currently employed in the Juneau area (2000 Census data). Based on the locations of offices within each hazard area it is conservatively assumed that 25% (4,175 people) of the employable population could be located within any of the three hazard areas at the time of a hazard event.

As described in Section 2 of this plan, tourism brings over 800,000 visitors per year to the Juneau area. As it is impossible to predict when a hazard may occur, it is also impossible to predict where visitors may be during an event. For this purposes of this project, it is conservatively assumed that 1% (8,000 people) of the yearly tourist population could be located within any of the three hazard areas at the time of a hazard event, based on a peak daily cruise ship visitation of 7,500 and 500 independent visitors.

Critical facilities as described in the Community Profiles Section of this hazard plan have been identified throughout the immediate project area and are displayed generically in Map 3 on page 20. An inventory of critical facilities as affected by each hazard is provided in each hazard section of this document. Facilities were designated as critical if they are: (1) vulnerable due to the type of occupant (children, elderly, hospitalized, etc.); (2) critical to the community's ability to function (roads, power generation facilities, water treatment facilities, etc.); (3) have a historic value to the community (cemetery, museum, etc.); or (4) critical to the community in the event of a hazard occurring (police, fire stations, hospitals, emergency operations centers, etc.).

Based on a pilot program FEMA and the Alaska Department of Emergency Services (ADES) has initiated to inventory critical facilities in Alaska, it should be taken into consideration that Alaska critical facilities vary fundamentally from other states. A local post office in a rural community in Alaska may also be the location of the police station, emergency operations center, hospital, and only store within 100 miles. While Juneau is Alaska's capital and therefore has a much larger population than the majority of cities in Alaska, to be consistent with the current Alaska inventory process the critical facilities identified in this hazard plan include all of the critical facilities identified for other communities in Alaska. The comprehensive list of facilities inventoried statewide is listed as follows:

- Airport
- Bridge
- Cemetery
- Church
- Civic Center
- Community Freezer
- Community Hall
- Community Storage Shed
- Emergency Operations Center
- Emergency Shelter
- Fire Station
- Fuel Storage Tanks (greater than 500 gal.)
- Generator
- Harbor/Dock/Port
- Hospitals and Emergency Room
- Landfill/Incinerator
- Library
- Museum
- National Guard
- NFIP
- Office
- Oil and Natural Gas Transmission Pipeline
- Park
- Police Station
- Post Office
- Potable Water Production and Treatment Facility
- Power Generation Facility
- Radio Transmitter
- Reservoir/Supply (Water)
- Road
- Satellite Dish
- School
- Senior Center
- Service Maintenance
- Sewage Lagoon
- Store
- Tannery
- Teachers Quarters
- Telephone
- Washeteria
- Waste Water Treatment Facility

This hazard plan includes an inventory of the above listed critical facilities from the CBJ Tax Assessor's database and CBJ Emergency Management Planning personnel.

Federal Requirements for Risk Assessment

Recent federal regulations for hazard mitigation plans outlined in 44 CFR Part 201.6 (c) (2) include a requirement for a risk assessment. This risk assessment requirement is intended to provide information that will help the community identify and prioritize mitigation activities that will prevent or reduce losses from the identified hazards. The federal criteria for risk assessments and information on how the CBJ All-Hazards Mitigation Plan meets those criteria is outlined below:

Table 4 Federal Requirements

Section 322 Requirement	How is this addressed?
Identifying Hazards	The CBJ has assembled a list of natural hazards that affect the jurisdiction and utilized the list when developing the Plan.
Profiling Hazard Events	The hazard-specific sections of the CBJ All-Hazards Mitigation Plan provide documentation for all of the large-scale natural hazards that may affect the Borough. Where information was available, the Plan lists relevant historical hazard events.
Assessing Vulnerability: Identifying Assets and Estimating Potential Losses	Vulnerability assessments for avalanche, landslide, and downtown fire have been completed and are contained within the hazard-specific chapters. Additional vulnerability assessments will be added as they are completed; approximately one per year.
Assessing Vulnerability: Analyzing Development Trends	The Community Profile Section of this plan provides a description of the development trends in the CBJ.

Economic Analysis

FEMA uses two approaches to economic analysis of mitigation projects: benefit/cost analysis and cost-effectiveness analysis. Conducting a benefit/cost analysis for a mitigation activity can assist communities in determining which projects are financially worth undertaking to avoid disaster losses in the future. Cost-effectiveness analysis evaluates how to best spend a given amount of money to achieve a specific goal. Determining the economic feasibility of mitigating natural hazards can provide decision-makers with an understanding of the potential benefits and costs of an activity, as well as a basis upon which to compare alternative projects.

The CBJ will use a FEMA-approved benefit/cost analysis approach to analyze and prioritize mitigation project ideas. The CBJ has contracted URS Corporation to complete the benefit/cost analyses for landslide, avalanche, and downtown fire hazards. Utilizing this approach and the information provided by URS Corporation, the CBJ will develop a prioritized list of mitigation actions to be undertaken and will periodically evaluate the effectiveness of these actions.

Only mitigation options with essentially no cost can be accurately assessed at this time. The data necessary to conduct an accurate cost-benefit analysis of mitigation options that require significant investments is not currently available, but will be added as resources allow further study. Consequently, some mitigation options that were determined by the planning team to be the most desirable, such as structural control of avalanches and landslides, require further study before feasibility can be determined.

Section 2: Community Profile

Community Overview

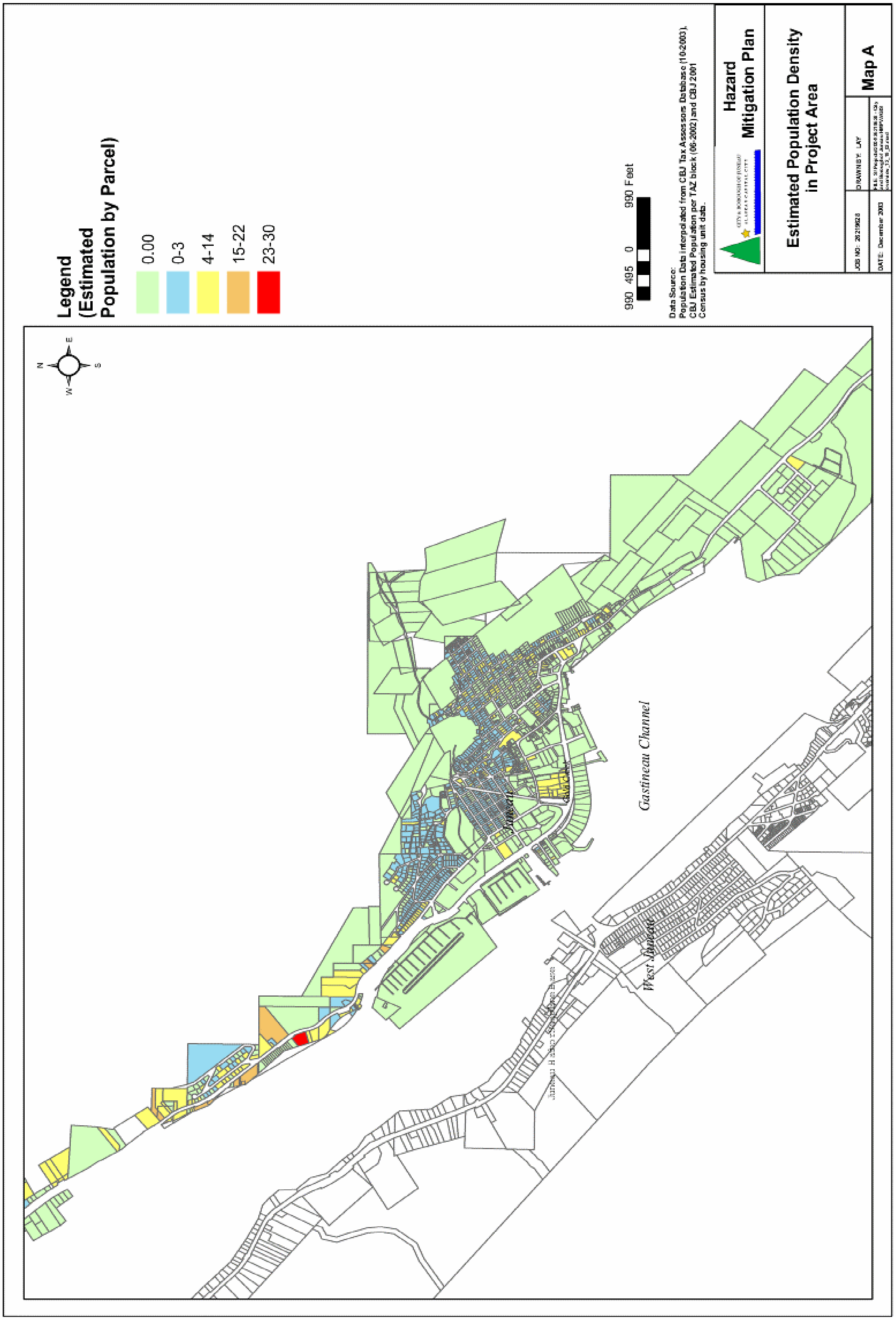
Juneau, Alaska's isolated, coastal capital city, is home to approximately 31,000 full-time residents. It is bordered to the east by British Columbia, Canada; to the north and northwest by Haines Borough; and to the south and southwest by the Tongass National Forest.

The area's climate is affected by warm, southerly winds which prevail over most of southeast Alaska. These winds bring mild but humid weather conditions typical of a maritime climate. The mean annual precipitation is 54 inches at the Juneau International Airport and includes 109 inches of snow. Normal conditions of alternating rain and snow prevent a large accumulation of snowfall at sea level. Weather conditions vary significantly throughout the Borough. As an example, the mean annual precipitation for downtown Juneau is 94 inches. The highest average monthly precipitation rates in the Borough occur in the fall when regional storms dominate; the lowest rates occur in late spring when local storms are more prevalent. The mean annual temperature is over 42°F. Average summer temperatures range from 44ºF to 65ºF and winter temperatures range from 25°F to 35°F. The highest temperature recorded at the Juneau International Airport is 90° F and the lowest is -22°F.

The area is characterized by mountains rising abruptly to over 4,000 feet and by the temperate rain forest that comprises the Tongass National Forest. Farther inland, the mountains are larger; reaching 8,000 feet and higher. The topography has been shaped by glacial action, exaggerating the steep mountain slopes and leaving U-shaped valleys through which the larger rivers flow. Fjords cut the coast and generally terminate in river valleys which extend through the mountain ranges and provide access to the interior. There are many smaller streams in the area that are swift and carry a great deal of silt and debris. Many derive a large percentage of their water from melting glaciers and consequently appear milky in color due to suspended solids.

The coastline and valleys of present-day Juneau were originally part of the territory of the Tlingit Indian Nation. The Tlingits possessed one of the most highly developed aboriginal cultures in North America, with a prosperous economy based on the abundant forest, fishing, and mineral resources of the southeast Alaska region.

Although the Hudson Bay Company operated a fur trading post south of Juneau in Taku Inlet from 1841 to 1843, the area was not permanently settled by whites until 1880. Juneau was settled by gold miners at this time and quickly became the mining center of southeast Alaska. In later years, it had the Alaska-Juneau Mill, at one time the largest low-grade, hard rock gold mine in the world. Douglas Island was the location of the famous Treadwell Mine, almost as large as the Alaska-Juneau Mine. In 1900, Juneau replaced Sitka as the capital of the Territory of Alaska. With Alaska's induction into statehood on January 3, 1958, Juneau became the state capital.



Map 2 Estimated Population Density in Project Area

Juneau, situated on the Gastineau Channel, is the largest population center in southeastern Alaska. It is located on the sheltered Inside Passage of southeast Alaska, 900 miles northwest of Seattle, Washington, and 75 miles from the open water of the Pacific Ocean. Anchorage, the largest city in Alaska, is 600 air miles northwest of Juneau.

Although the Borough encompasses a large area, only a small percentage is suitable for development as the area is composed of remote areas with steep slopes and glaciers. The most rapidly developing area in recent years and also the most densely populated residential area in the Borough is the Mendenhall Valley, reaching from Juneau International Airport north to Mendenhall Lake and Glacier. The valley is bordered by steep mountains with the Mendenhall River traversing the valley center. The river flows from Mendenhall Lake to the Gastineau Channel with only a 60-foot drop in elevation. Flowing into the Mendenhall River from the west side is Montana Creek which originates from Windfall Lake approximately 10 miles away. Duck and Jordan Creeks parallel the Mendenhall River to the east and flow into the Gastineau Channel at the airport.

Due to topography and the pattern of available land, development in the CBJ has continued in a linear fashion that follows the shoreline. Additional development is expected along the Glacier Highway and on Douglas Island in the future.

Juneau is accessible only by air and sea. Scheduled jet flights and air taxis are available daily at the municipally-owned Juneau International Airport. The airport includes a paved 8,456-foot runway and a seaplane landing area. Marine facilities include a seaplane landing area at Juneau Harbor, two deep draft docks, five small boat harbors and a State ferry terminal. The Alaska Marine Highway System and cargo barges provide year-round services.

The State of Alaska, CBJ, and federal agencies provide nearly 45% of the employment in the community. Juneau is home to State Legislators and their staff during the legislative session between January and May. Tourism is a significant contributor to the private sector economy during the summer months, providing a $130 million income and nearly 2,000 jobs. Over 700,000 visitors arrive by cruise ship, and another 100,000 independent travelers visit Juneau each year. This sector has experienced growth each year for the last decade. Support services for logging and fish processing contribute to the Juneau economy, and 519 residents hold commercial fishing permits. Douglas Island Pink and Chum (DIPAC), a private non-profit organization, operates a fish hatchery which increases the local salmon population. The Kennecott Greens Creek Mine produces gold, silver, lead and zinc, and is the largest silver mine in North America.

Community Assets

This section outlines the resources, facilities and infrastructure that, if damaged, could significantly impact public safety, economic conditions, and environmental integrity of the CBJ.

Critical Facilities: Those facilities and infrastructure necessary for emergency response efforts. This definition differs from that utilized in the hazard-specific vulnerability assessments.

- Glacier Fire Station
- Juneau Fire Station
- Douglas Fire Station
- Auke Bay Fire Station
- Lynn Canal Fire Station
- Juneau Police Department Station
- Water Treatment Facilities
- Public Works Building
- Power Substation
- Ferry Terminal
- Juneau International Airport
- Bartlett Hospital

Essential Facilities: Those facilities and infrastructure that supplement response efforts.

- Designated Shelters
- City Hall Buildings

Critical Infrastructure: Infrastructure that provides services to the CBJ.

- Telephone lines
- Power lines
- Transportation networks
- Bridges
- Water lines
- Wastewater collection

Vulnerable Populations: Locations serving population that have special needs or require special consideration.

- Fireweed Apartments (elderly housing)
- Homeless/transient camps
- R/V parks
- Mobile home parks
- CBJ area schools
- Wildflower Court

- Bartlett Hospital

Cultural and Historical Assets: Those facilities that augment or help define community character, and, if lost, would represent a significant loss for the community.

- State of Alaska, Division of Archives and Records
- State Museum
- Historical downtown buildings

Environmental Assets: Environmental assets are those parks, open spaces, wetlands, and rivers that provide an aesthetic and functional service for the community. The list of environmental assets in the Juneau area is very long, and includes:

- Cope Park
- Sandy Beach
- Juneau Trail System (Perseverance Trail, Treadwell Ditch Trail, etc)
- Tongass National Forest, which includes the Mendenhall Glacier and River, and the Mendenhall Wildlife Refuge

Community Resources

This section outlines the resources available to the CBJ for mitigation and mitigation related funding and training.

Federal Resources

The federal government requires local governments to have a hazard mitigation plan in place to be eligible for funding opportunities through FEMA such as the Pre-Disaster Mitigation Assistance Program and the Hazard Mitigation Grant Program. The Mitigation Technical Assistance Programs available to local governments are also a valuable resource. FEMA may also provide temporary housing assistance through rental assistance, mobile homes, furniture rental, mortgage assistance, and emergency home repairs. The Disaster Preparedness Improvement Grant also promotes educational opportunities with respect to hazard awareness and mitigation.

FEMA, through its Emergency Management Institute, offers training in many aspects of emergency management, including hazard mitigation. FEMA has also developed a large number of documents that address implementing hazard mitigation at the local level. Five key resource documents are available from FEMA Publication Warehouse (1-800-480-2520) and are briefly described below:

- **How-to Guides.** FEMA has developed a series of how-to guides to assist states, communities, and tribes in enhancing their hazard mitigation planning capabilities. The first four guides mirror the four major phases of hazard mitigation planning used in the development of the CBJ Hazard Mitigation Plan. The last five how-to guides address special topics that arise in hazard mitigation planning such as conducting cost-benefit analysis and preparing multi-jurisdictional plans. The use of worksheets, checklists, and tables make these guides a practical source of guidance to address all stages of the hazard mitigation planning process. They also include special tips on meeting Disaster Mitigation Act (DMA) 2000 requirements (http://www.fema.gov/fima/planhowto.shtm).

- **Post-Disaster Hazard Mitigation Planning Guidance for State and Local Governments.** FEMA DAP-12, September 1990. This handbook explains the basic concepts of hazard mitigation and shows state and local governments how they can develop and achieve mitigation goals within the context of FEMA's post-disaster hazard mitigation planning requirements. The handbook focuses on approaches to mitigation, with an emphasis on multi-objective planning.
- **Mitigation Resources for Success CD.** FEMA 372, September 2001. This CD contains a wealth of information about mitigation and is useful for state and local government planners and other stakeholders in the mitigation process. It provides mitigation case studies, success stories, information about Federal mitigation programs, suggestions for mitigation measures to homes and businesses, appropriate relevant mitigation publications, and contact information.
- **A Guide to Federal Aid in Disasters.** FEMA 262, April 1995. When disasters exceed the capabilities of state and local governments, the President's disaster assistance program (administered by FEMA) is the primary source of federal assistance. This handbook discusses the procedures and process for obtaining this assistance, and provides a brief overview of each program.
- **The Emergency Management Guide for Business and Industry.** FEMA 141, October 1993. This guide provides a step-by-step approach to emergency management planning, response, and recovery. It also details a planning process that businesses can follow to better prepare for a wide range of hazards and emergency events. This effort can enhance a business's ability to recover from financial losses, loss of market share, damages to equipment, and product or business interruptions. This guide could be of great assistance to the CBJ's industries and businesses located in hazard prone areas.

Other federal resources include:

- **Department of Agriculture.** Assistance provided includes: Emergency Conservation Program, Non-Insured Assistance, Emergency Watershed Protection, Rural Housing Service, Rural Utilities Service, and Rural Business and Cooperative Service.
- **Department of Energy, Office of Energy Efficiency and Renewable Energy, Weatherization Assistance Program.** This program minimizes the adverse effects of high energy costs on low-income, elderly, and handicapped citizens through client education activities and weatherization services such as an all-around safety check of major energy systems, including heating system modifications and insulation checks.
- **Department of Housing and Urban Development, Office of Homes and Communities, Section 108 Loan Guarantee Programs.** This program provides loan guarantees as security for federal loans for acquisition, rehabilitation, relocation,

clearance, site preparation, special economic development activities, and construction of certain public facilities and housing.

- **Department of Housing and Urban Development, Community Development Block Grants.** Provides grant assistance and technical assistance to aid communities in planning activities that address issues detrimental to the health and safety of local residents, such as housing rehabilitation, public services, community facilities, and infrastructure improvements that would primarily benefit low-and moderate-income persons.
- **Department of Labor, Employment and Training Administration, Disaster Unemployment Assistance.** Provides weekly unemployment subsistence grants for those who become unemployed because of a major disaster or emergency. Applicants must have exhausted all benefits for which they would normally be eligible.
- **Federal Financial Institutions.** Member banks of FDIC, FRS or FHLBB may be permitted to waive early withdrawal penalties for Certificates of Deposit and Individual Retirement Accounts.
- **Internal Revenue Service, Tax Relief.** Provides extensions to current year's tax return, allows deductions for disaster losses, and allows amendment of previous tax returns to reflect loss back to three years.
- **United States Small Business Administration.** May provide low-interest disaster loans to individuals and businesses that have suffered a loss due to a disaster. Requests for SBA loan assistance should be submitted to the Alaska Division of Homeland Security and Emergency Management.

Other resources: The following are Web sites that provide focused access to valuable planning resources for communities interested in sustainable development activities.

- **Federal Emergency Management Agency,** http://www.fema.gov – includes links to information, resources, and grants that communities can use in planning and implementation of sustainable measures.
- **American Planning Association,** http://www.planning.org – a non-profit professional association that serves as a resource for planners, elected officials, and citizens concerned with planning and growth initiatives.
- **Institute for Business and Home Safety,** http://ibhs.org **–** an initiative of the insurance industry to reduce deaths, injuries, property damage, economic losses, and human suffering caused by natural disasters. Online resources provide information on natural hazards, community land use, and ways citizens can protect their property from damage.

State Resources

ADES is responsible for coordinating all aspects of emergency management for the State of Alaska. Public education is one of its identified main categories for mitigation efforts.

Improving hazard mitigation technical assistance for local governments is another high priority list item for the State of Alaska. Providing hazard mitigation training, current hazard information, and the facilitation of communication with other agencies would encourage local hazard mitigation efforts. ADES provides resources for mitigation planning on their Web site at http://www.ak-prepared.com.

Other state resources include:

- **Division of Senior Services:** Provides special outreach services for seniors, including food, shelter and clothing.
- **Division of Insurance:** Provides assistance in obtaining copies of policies and provides information regarding filing claims.
- **Department of Military and Veteran's Affairs:** Provides damage appraisals and settlements for VA-insured homes, and assists with filing of survivor benefits.

Other Funding Sources and Resources

- **American Red Cross.** Provides for the critical needs of individuals such as food, clothing, shelter, and supplemental medical needs. Provides recovery needs such as furniture, home repair, home purchasing, essential tools, and some bill payment may be provided.
- **Crisis Counseling Program.** Provides grants to State and Borough mental health departments, which in turn provide training for screening, diagnosing and counseling techniques. Also provides funds for counseling, outreach, and consultation for those affected by disaster.

Local Resources

The CBJ has a number of planning and land management tools that will allow it to implement hazard mitigation activities. The resources available in these areas have been assessed by the CBJ, and are summarized in the following tables:

Table 5 Legal and Regulatory Capability

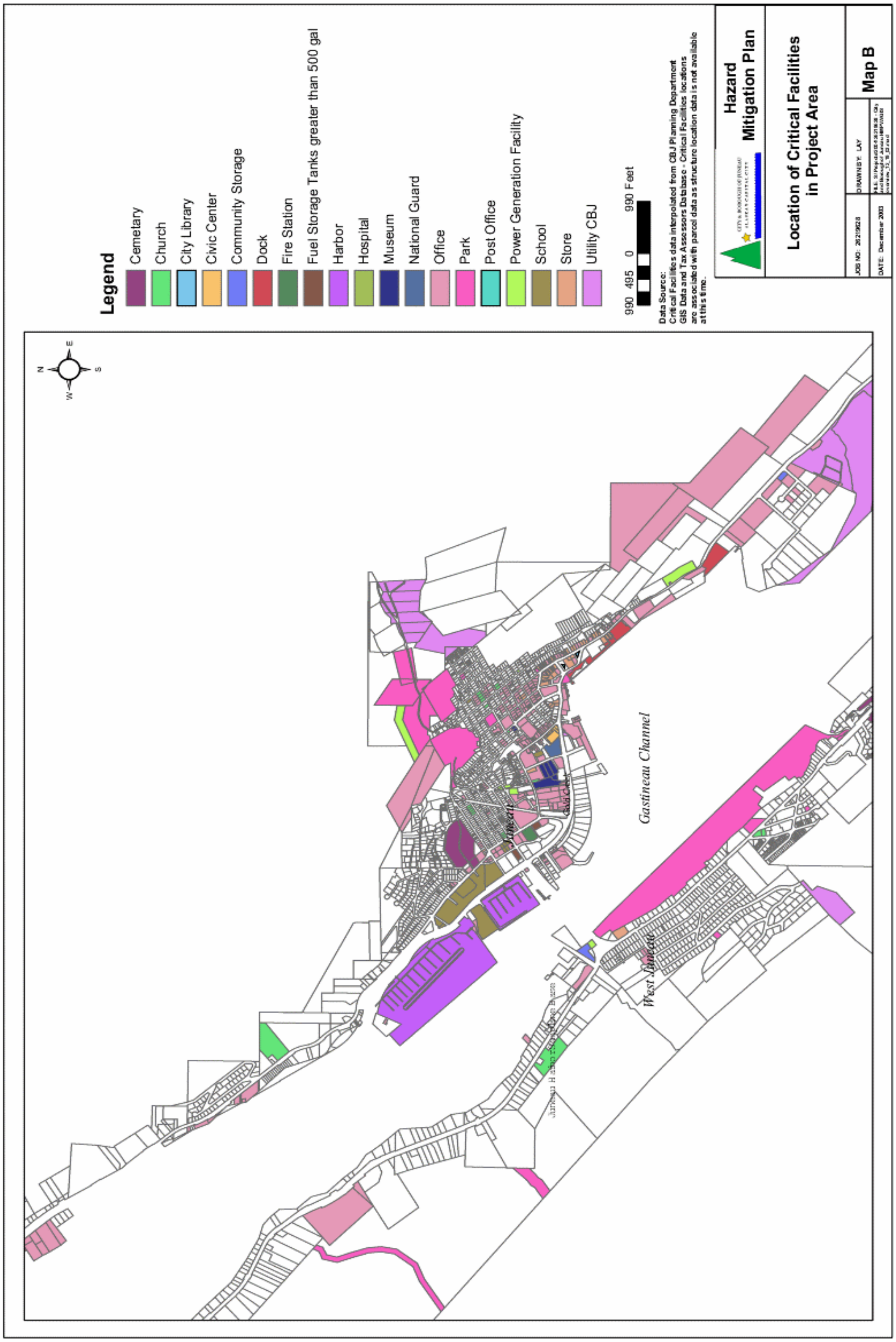
Regulatory Tools (ordinances, codes, plans)	Local Authority (Y/N)	County/Regional Authority (Y/N)	Does State Prohibit? (Y/N)	Comments (Year of most recent update; problems administering it, etc)
Building code	Y	Y	N	
Zoning ordinance	Y	Y	N	
Subdivision ordinance or regulations	Y	Y	N	
Special purpose ordinances (floodplain management, stormwater management, hillside or steep slope ordinances, wildfire ordinances, hazard setback requirements)	Y	Y	N	Floodplain, avalanche and landslide, sand and gravel, streamside setbacks, hillside development, coastal management, wetlands, drainage and earth-moving requirements
Growth management ordinances (also called "smart growth" or anti-sprawl programs)	Y	Y	N	Urban Service Boundary, Mixed-Use zoning, planned unit developments
Site plan review requirements	Y	Y	N	
General or comprehensive plan	Y	Y		Last update 2003
A capital improvements plan	Y	Y		Plan covers 2004-2009; five year CIP produced annually
An economic development plan	N	N	N	
An emergency response plan	Y	Y		Emergency Operations Plan adopted July 2003
A post-disaster recovery plan	N	N	N	
A post-disaster recovery ordinance	N	N	N	
Real estate disclosure requirements	N	N		Realtors are obliged to disclose hazards to the best of their knowledge

Table 6 Administrative and Technical Capability

Staff/Personnel Resources	Y/N	Department/Agency and Position
Planner(s) or engineer(s) with knowledge of land development and land management practices	Y	Community Development Department (CDD), Engineering Department
Engineer(s) or professional(s) trained in construction practices related to buildings and/or infrastructure	Y	CDD, Engineering Department, and Fire Department
Planners or Engineer(s) with an understanding of natural and/or human-caused hazards	Y	CDD, Engineering Department, Fire Department, and Public Works Department
Floodplain manager	Y	CDD ensures adherence to FEMAprogram, administers land use code with floodplain ordinance
Surveyors	Y	Engineering Department
Staff with education or expertise to assess the community's vulnerability to hazards	Y	CDD, Emergency Management
Personnel skilled in GIS and/or HAZUS	Y	CDD - GIS Manager
Scientists familiar with the hazards of the community	N	CBJ relies on scientific expertise of local agencies or of consultants
Emergency manager	Y	Manager's Office, Emergency Management Coordinator
Grant writers	N	Staff within departments write grants as a collateral duty
Environmental Advisory Council	N/Y	Wetland Review Board fulfills this function for wetland related projects

Table 7 Fiscal Capability

Financial Resources	Accessible or Eligible to Use (Yes/No/Don't Know)
Community Development Block Grants (CDBG)	Y
Capital improvements project funding	Y
Authority to levy taxes for specific purposes	Y
Fees for water, sewer, gas, or electric service	Y
Impact fees for homebuyers or developers for new developments/homes	N
Incur debt through general obligation bonds	Y
Incur debt through special tax and revenue bonds	Y
Incur debt through private activity bonds	N
Withhold spending in hazard-prone areas	Y



Map 3 Location of Critical Facilities in Project Area

Section 3: Hazards

AVALANCHE

Avalanches take more lives nationwide than any other natural disaster event. Most avalanche deaths result from snow sport activities such as skiing, snowboarding, and snowmobiling, and the majority of the time the victim triggers the fatal avalanche. Avalanches tend to occur repeatedly in localized areas and can shear trees, cover communities and transportation routes with packed snow and debris, destroy buildings, and kill people caught by slides.

Avalanches are of special concern to Juneau because parts of the city are located directly beneath avalanche paths. National experts consider Juneau to have one of the most hazardous avalanche areas in the country because of the combined threat from the Behrends and White paths as well as the many paths that empty onto Thane Road. Avalanches have hit, damaged or destroyed at least 72 buildings within a 10-mile radius of downtown Juneau in the past century.

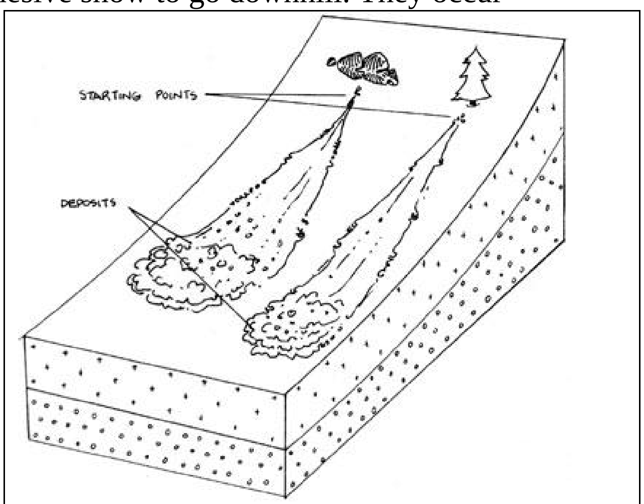
Hazard Description and Characterization

A snow avalanche is a swift, downhill-moving snow mass. The amount of damage is related to the size of the slide, type of avalanche, the composition and consistency of the material in the avalanche, the force and velocity of the flow, and the avalanche path.

Avalanche Types

Loose Snow Avalanches

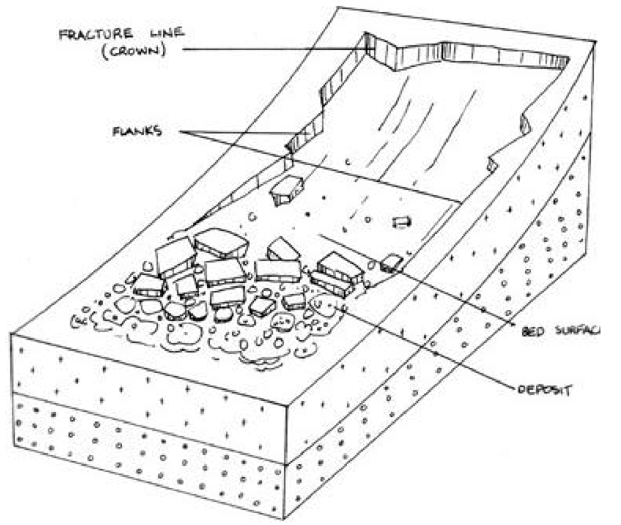
Loose snow avalanches, sometimes called point releases, generally occur when a small amount of uncohesive snow slips and causes more uncohesive snow to go downhill. They occur frequently as small local sloughs which remove excess snow (involving just the upper layers of snow) keeping the slopes relatively safe. They can be large and destructive, though. For example, wet loose snow avalanches occurring in the spring are very damaging. Loose snow avalanches can also trigger slab avalanches. Loose snow avalanches typically occur on slopes above 35 degrees, leaving behind an inverted V-shaped scar. They are often caused by snow overloading (common during or just after a snowstorm) or warming (triggered by rain, rising temperatures or solar radiation).



Loose snow avalanche. Image courtesy of the Canadian Avalanche Association.

Slab Avalanches

Slab avalanches are the most dangerous types of avalanches. They happen when a mass of cohesive snow breaks away and travels down the mountainside. Slab avalanches occur as a result of the presence of structural weaknesses within interfacing layers of the snowpack. The weakness exists when a relatively strong, cohesive snow layer overlies weaker snow or is not well bonded to the underlying layer. The weaknesses are caused by changes in the thickness and type of snow covers due to changes in temperature or multiple snowfalls.



Slab avalanche. Image courtesy of the Canadian Avalanche Center.

The interface fails for several reasons. It can fail naturally due to earthquakes, blizzards, temperature changes or other seismic and climatic causes, or artificially by human activity. When a slab is released, it accelerates, gaining speed and mass as it travels downhill. Slabs can range in thickness from less than an inch to 35 feet or greater.

Cornice Collapse

A cornice is an overhanging snow mass formed by wind blowing snow over a ridge crest or the sides of a gulley. The cornice can break off and trigger bigger snow avalanches when it hits the wind-loaded snow pillow.

Ice Fall Avalanches

Ice fall avalanches result from the sudden fall of broken glacier ice down a steep slope. They can be unpredictable as it is hard to know when ice falls are imminent. Despite common belief, they are unrelated to temperature, time of day or other typical avalanche factors.

Avalanche Terrain Factors

There are several factors that influence avalanche conditions, with the main ones being slope angle, slope aspect and terrain. Other factors include slope shape, vegetation cover, elevation, and path history. Avalanches usually occur on slopes 35 to 60 degrees and can occur on slopes of 25-35 degrees, but are not as likely at that slope angle because gravity does not sufficiently stress the weak layers of the snow pack. As slope angles above 70º, the snow tends to slough off and does not have the opportunity to accumulate. Avalanches can occur outside the optimum slope angle range, but are not as common.

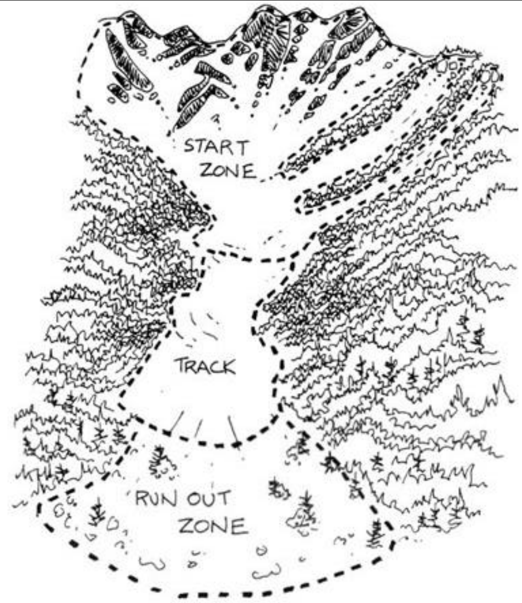
Slope aspect, also termed orientation, describes the direction a slope faces with respect to the wind and sun. Leeward slopes(slopes facing away from wind and snow) loaded by wind-transported snow are problematic because the wind-deposited snow increases the stress and enhances slab formation. Intense direct sunlight can weaken and lubricate the bonds between the snow grains, weakening the snowpack. Shaded slopes are also potentially unstable because the weak layers may be held for a longer time in an unstable state.

The local terrain features determine an avalanche's path. The path has three parts: the starting zone, the track, and the run-out zone. The starting zone is where the snow breaks loose and starts sliding. It's generally near the top of a canyon, bowl, ridge, etc., with steep slopes between 25 and 50 degrees. Snowfall is usually significant in this area.

The track is the actual path followed by an avalanche. The track can have milder slopes, between 15 and 30 degrees, but it is where the snow avalanche will reach maximum velocity and mass. Tracks can branch or converge, creating successive runs that increase the threat, especially when multiple releases share a run-out zone.

The run-out zone is a gentler slope at the path base where the avalanche slows down, resulting in snow and debris deposition.

The impact pressure determines the amount of damage caused by a snow avalanche. The impact pressure is related to the density, volume (mass) and velocity of the avalanche.



Avalanche path. Image courtesy of the Canadian Avalanche Association.

Urban Avalanches

Avalanche fatalities are common in areas where winter sports are popular. The most well-known avalanche deaths are those involving skiers, snowmobilers and snowboarders; however urban avalanche events that interface with infrastructure have proven to be particularly deadly and have occurred with relative frequency around the world. In many events, the avalanche danger was well known by both residents and officials; however the avalanches occurred before any decisive action could be taken.

Table 8 Sample of Fatal Urban Avalanche Events 1900-2002

Where	When	Fatalities
Stevens Pass, Washington	3-1-1910	96
Blons, Austria	January 1954	56
Santa Valley, Peru	1-10-62	Up to 4,000
Val d'Isere, France	1971	39
Chamonix, France	1971	72
Azob Pass, Tajikistan	October 1997	46

Where	When	Fatalities
Roudehen, Iran	1-13-98	32
Dushanbe, Tajikistan	2-23-98	11
Darbandi, Afghanistan	4-7-98	70
Kangiqsualujjuaq, Quebec	1-1-99	9
Gorkha, Nepal	1-2-99	6
Montroc, France	2-9-99	12
Galtuer, Austria	3-2-99	20
Valzur, Austria	3-4-99	5
Karmadon, Russia	9-21-02	100-150

Urban avalanches that do not prove fatal are also significant as they can result in interrupted utility services, delays in emergency response, and damage to roads and other infrastructure.

Local Avalanche Hazard Identification

Juneau is one of the most hazardous avalanche areas in the country in terms of the number of residential structures exposed to slides. In the past 100 years, more than 70 buildings within 10 miles of downtown Juneau have been hit, damaged or destroyed by avalanches. At present, Juneau has 60 buildings, including one hotel, in high avalanche hazard zones; plus an expressway and a boat harbor.

During the ski season, Eaglecrest Ski Patrol provides daily avalanche bulletins relating to conditions on mountains around the ski area. These conditions can generally be assumed to reflect conditions on the mountains around downtown Juneau.

Avalanche Classification and Terminology

Avalanche Return Intervals:

Most avalanches in a given path are relatively small and frequent, affecting only a small portion of the potential path area. Occasionally, much larger avalanches release which extend nearly to the observed limits of the path. These larger events are usually referred to as “10 year” events but in reality, reflect an order of magnitude return period between 3 years and 30 years. On rare occasions, exceptionally large avalanches occur which extend well beyond the established boundaries of the paths. These avalanches, often referred to as “100 year” avalanches, are likely to affect all or most of the potential path area.

A design avalanche is defined as an avalanche occurring within an order of magnitude range between 30 years and 300 years. Statistically, design avalanches have a 1% probability of occurring during any given year, but could occur in consecutive years or many years apart.

For the purposes of this report, "return intervals" have been calculated for each relevant avalanche path. The concept of return intervals is not intended to provide a forecast or estimate for the future occurrence of a large avalanche; rather it is used as a general quantifier for the hazard a given path presents. A long return interval generally indicates a less frequent, but larger, slide. For instance, based on historical information, the return interval for large avalanches in the Behrends Avenue path is estimated to be approximately 14.4 years, based upon 7 major events in 101 years (1890, 1917, 1926, 1935, 1946, 1962, and 1985). The number of years of historical record for avalanches affecting the White Subdivision is even shorter than the Behrends Avenue path. Buildings in the White path have been hit on four occasions in the past ten years. Based on data from the last 29 years (the period of record), the return period for large avalanches affecting private property in the White path is 3.6 years. This does not imply that a damaging avalanche is certain to occur within those return intervals, but rather provides a general guideline for estimating the risk for each path.

Little is known about the avalanche history of the smaller paths affecting newer areas of White Subdivision because development is relatively recent and no records have been routinely maintained by the CBJ.

Snow Avalanche Hazard Classifications

High Hazard/Severe Hazard/High Severity Zones are subject to avalanches with:

a. return periods of less than 30 years, and
b. impact pressures of greater than 600 lbs/ft^2

Special Engineering/Moderate Hazard Zones are subject to avalanches with:

a. return periods between 30 and 300 years, and
b. impact pressures less than 600 lbs/ft^2

Juneau-area Urban Avalanche Vulnerability

There are 62 houses, 1 hotel, 2 sections of the Egan Expressway (at the Behrends Avenue and White Subdivision paths), 2 major thoroughfares (Glacier Highway/Egan Drive and Thane Road), a number of streets and roads (in the Behrends Avenue and White Subdivision paths, plus Basin Road), the Flume between Gold Creek and Evergreen Avenue, and much of Aurora Basin boat harbor in mapped avalanche zones. There are 40 residential homes in the severe hazard zone and 22 plus the Breakwater Inn hotel in the moderate hazard zone.

These paths have the potential to produce very large and destructive avalanches. Avalanches have occurred since the houses have been built but none of those slides were the largest that any given path could produce. Historical reports of much larger slides exist, and it is likely that the largest possible avalanches have not yet occurred in the relatively short period of time since the town of Juneau was established. These major events could far exceed anything in the historical record.

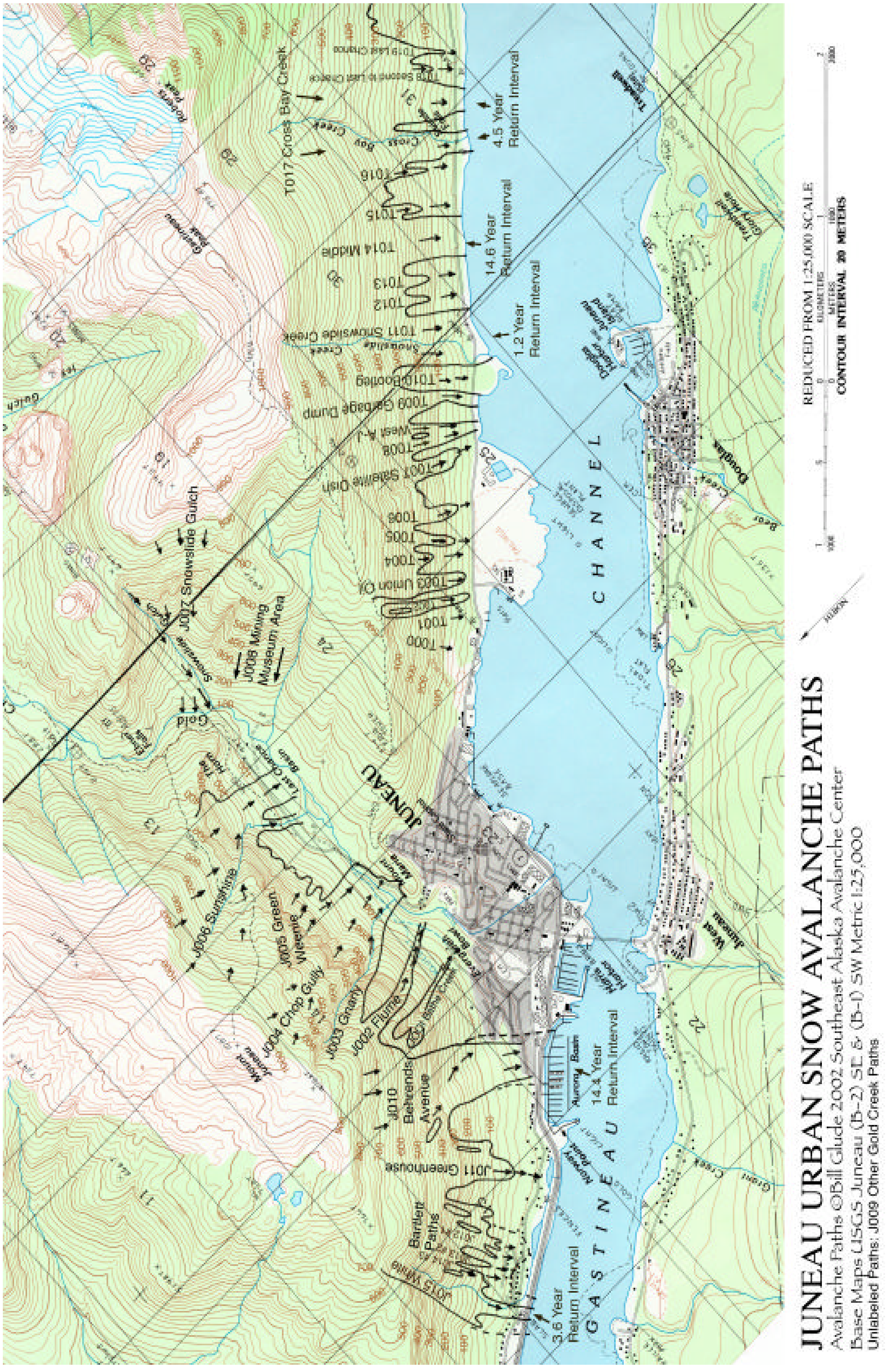
A very large avalanche could destroy buildings, sweep vehicles off roads, and damage or destroy boats in Aurora Basin. Such catastrophic slides could also block Glacier Highway and the Egan

Expressway at the White and Behrends Avenue paths. Large slides can also occur on Thane Road and in heavily used areas near Basin Road.

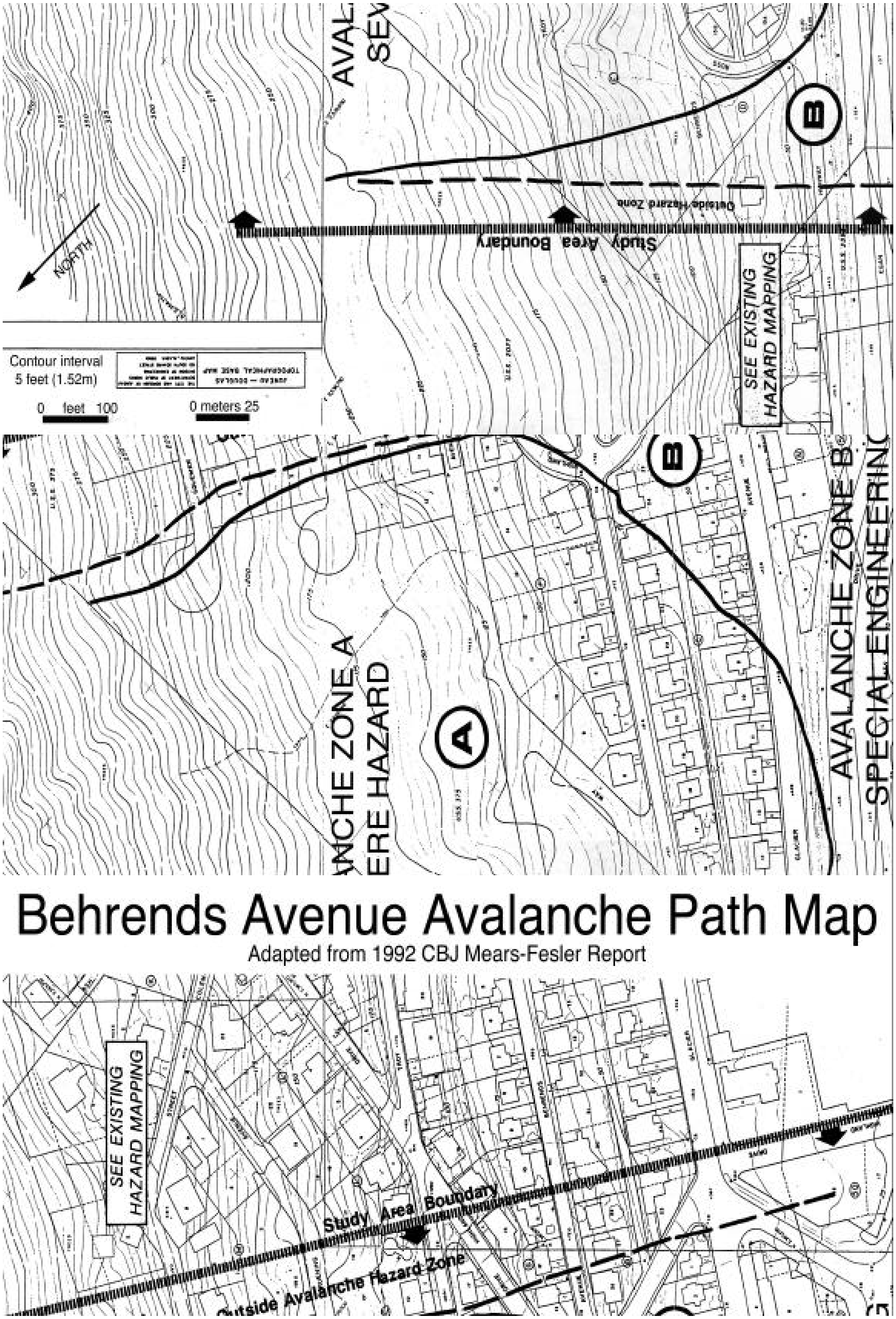
Table 9 Juneau Avalanche Path Systems

Path	Details
Behrends	14.4 year return interval. Threatens 42 residential homes; 31 in severe hazard zone. 1 hotel and harbor in moderate hazard zone. Slides can cross Glacier Highway and Egan Expressway.
Gold Creek -Mt Juneau (multiple paths)	Paths include Bathe Creek, Flume, Gnarly, Chop Gully, Green Weenie, and Sunshine. Slides can affect the Flume, Basin Road, and lower Perseverance Trail.
Gold Creek -Snowslide Gulch	Affects Gold Creek and the A-J Mine drainage tunnel; dusts Perseverance Trail and the Mining Museum footbridge. Slide from this path dammed Gold Creek in 2001.
Greenhouse	Not mapped as affecting houses or roads, but can reach Glacier Highway.
Thane Road (multiple paths)	19+ paths. State of Alaska Department of Transportation (DOT) conducts avalanche control via explosives.
Unmapped	Unmapped paths above Gastineau Avenue and South Franklin Street.
White	3.6 year return interval. Threatens 20 residential homes; 9 in severe hazard zone. Slides can reach Old Glacier Highway and Egan Expressway.

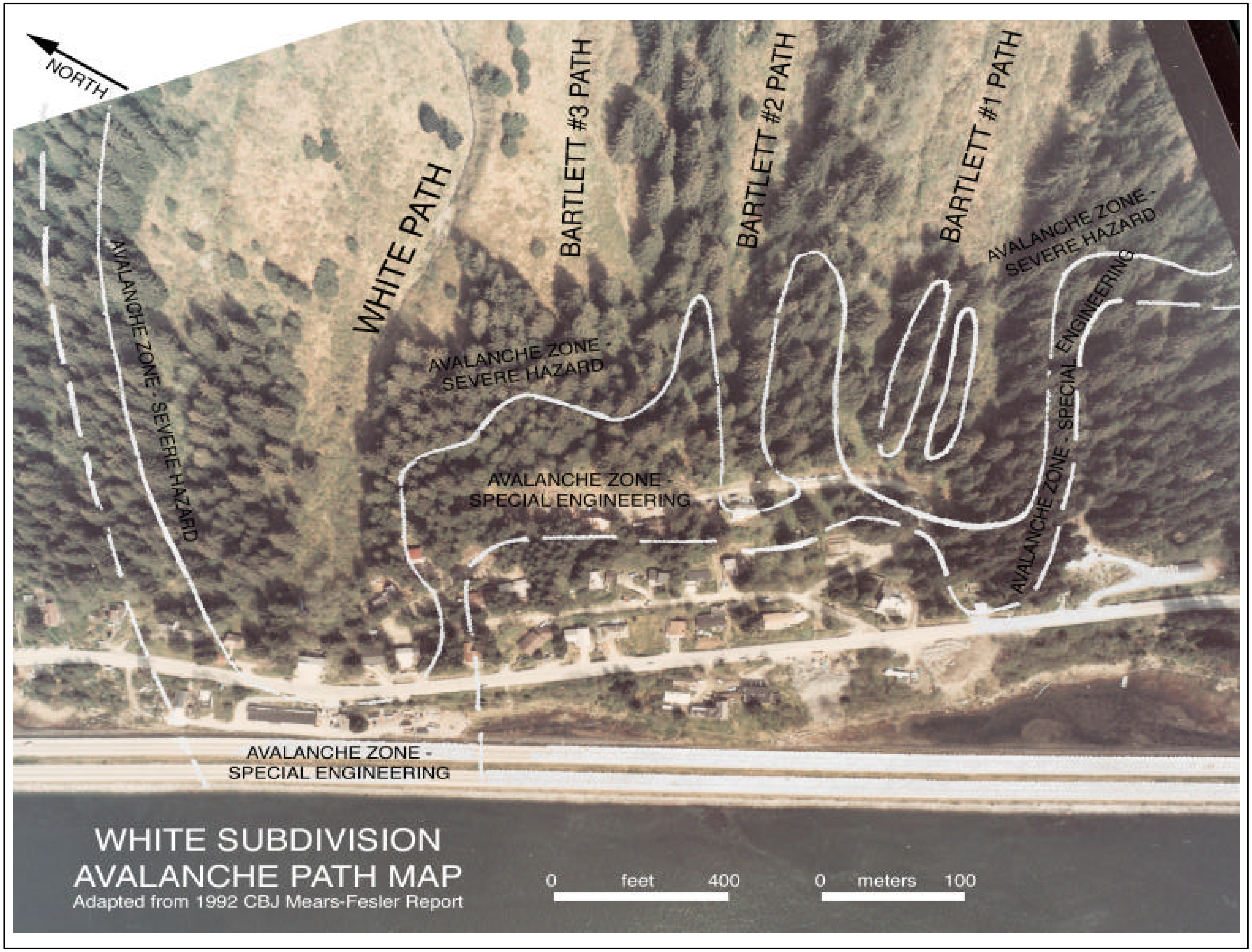
White Subdivision residence after avalanche of February 20, 1985. Only the second story is visible above the avalanche debris. Photo by Doug Fesler.



Map 4 Juneau Snow Avalanche Paths



Map 5 Behrends Avenue Avalanche Path



Map 6 White Subdivision Avalanche Path Map

Juneau Urban Avalanche History

The information contained in this summary was researched and compiled by Doug Fesler, Jill Fredston, and Art Mears of the Alaska Mountain Safety Center, Inc. Although not a complete history of the Behrends Avenue and White Subdivision avalanche paths, this inventory represents the most complete history ever compiled and is based upon the best information available at the time the report was written(1991). Numerous other local avalanche paths produce dozens of avalanches each year.

Table 10 Avalanche History of the Behrends and White Paths

Behrends Avenue Path	
Date	**Details**
1890	A large avalanche reportedly reached tidewater in the vicinity of present day Aurora Basin Small Boat Harbor
March or April, 1917	A large slide with significant powder blast reportedly blocked the road (the predecessor of Glacier Highway) and destroyed a considerable number of trees, but did not reach the beach.
1926	A large slide reportedly stopped 300' above Glacier Highway, although one finger blocked the road and reached tidewater.
1935	A large wet slab avalanche reportedly crossed Glacier Highway, blocking the road below the present-day subdivision.
1946	A large wet slab avalanche reportedly stopped in the trees (in the vicinity of present day Behrends Avenue), just above 1735 Glacier Avenue.
March 12, 1962	A moderate sized avalanche with debris approximately 10'-15' deep and 600' wide stopped approximately 375' above Behrends and Troy Avenues.
March 22, 1962, 5:30 am	The most destructive avalanche in recent years. Approximately 35 residential structures on three streets were damaged, seven with severe damage and ten with moderate damage. In addition, considerable personal property, numerous vehicles, utility poles, power and telephone lines, fences, and trees were destroyed or damaged.
Winter 1965-66	40 small slides recorded.
February 10, 1966, 11am	Debris stopped approximately 1000' above the subdivision.
February 17, 1966, 12:30pm	Debris stopped approximately 350'-450' above the subdivision on the east side. 17 other small slides were also recorded from same storm in the same path.
February 22, 1966, 2pm	A large wet slab avalanche fell along the eastern side of the path, terminating approximately 400' up slope from the subdivision. A second long running slide descended the central portion of the path, stopping 500'-600' above the subdivision. Four other small slides were recorded during this storm in this path.
February 28, 1966	22 small avalanches were recorded on this date.
March 14, 1966	Numerous small loose snow and wet slab releases were observed on this date.
April 3, 1966, 3pm	A moderate size wet slab avalanche terminated approximately 800' above the subdivision.
April 9, 1966	A large wet slab release was reported.
January 10, 1971, 1:30pm	The only avalanche fatality known to have occurred in the Behrends Avenue path resulted on this date when a mountain climber descended into the upper part of the path, triggering a slide. Four slides reportedly fell during the day, causing powder blast to extend into the subdivision and nearly to tidewater.

Behrends Avenue Path	
Date	**Details**
February 21, 1971, 10:30am	A moderate size avalanche with debris 8'-10' deep and 200' wide stopped 400'-450' above houses.
March 3, 1971, 5:30pm	A moderate avalanche reportedly dusted the subdivision and deposited some snow (from powder blast)in the yards of houses in Behrends before terminating in the vicinity of Glacier Ave. The debris flow stopped short of the subdivision.
April 3, 1971, 8am	A moderate sized avalanche stopped approximately 800' above 232 Behrends Avenue.
March 1972, prior to 8am	Two moderate sized slides descended the eastern and western sides of the path, stopping approximately 800' above the houses on Behrends Avenue. A third slide stopped in the gully.
December 16, 1975, 12:15pm	An avalanche of unknown dimensions descended Behrends path on this date.
January 1980	A moderate sized avalanche "dusted" the subdivision with powder blast that continued to tidewater. Debris stopped short of reaching the subdivision.
March 7, 1982	A large avalanche stopped in the trees just above the subdivision.
February 26, 1985 4-5pm	Four or five small slides were reported during the day with one larger slide terminating at the base of the mountain above the subdivision.
February 26, 1985, 8:10pm	Debris from a large slide, the largest in recent years, hit and damaged one residential structure and stopped short of hitting several others.
1990-91 winter	Two avalanches occurred during this winter, one extending from the base of the transverse gully on the eastern side and one from the drainage of the western creek, terminating approximately 500' up slope from the houses on Behrends Avenue.
White Path	
Date	**Details**
March 22, 1962	A large slide extended into the trees above Glacier Highway extending nearly to the edge of the highway.
February 16, 1971	A large wet slide extended into the trees above homes.
January 19, 1972, 10:37 am	A soft slab avalanche triggered by strong NE winds terminated in the trees, at the base of the gully.
March 11, 1972	A small-moderate sized avalanche reportedly terminated approximately 1000' above nearest houses on Glacier Ave.
Winter/Spring 1981	A large avalanche hit the gray condominium on Glacier Avenue while it was under construction. Debris came through the 2 X 4 frame walls and into the basement.
January 2, 1985	An avalanche 12' deep and 60' wide stopped approximately 30' above homes.
January 14, 1985	An avalanche of unknown size reportedly stopped short of reaching the subdivision.
February 20, 1985, 9:50pm	A large avalanche hit and damaged one residential structure and partly buried one vehicle and a cache of building materials.

White Path	
Date	**Details**
March 18, 1985, 5:30am	A large avalanche hit and damaged one residential structure and stopped short of several others.
January 25, 1989	A large avalanche with debris measuring 8'-12' deep and 200' wide stopped 30' above homes.
February 22, 1990	A large avalanche hit one house and missed another house by 20'.
March 1991	A large slide reached Wickersham Avenue.

Avalanche Hazards Summary

Potential Damage

- Damage/destruction of structures
- Damage to infrastructure
- Transportation interruption
- Power interruption
- Loss of commerce

Impacts to Humans

- Loss of life
- Crushing/impact injuries
- Displaced persons/lack of shelter

Residents examine debris and powderblast damage from March 22, 1962 Behrends Avenue avalanche.

Avalanche Hazard Vulnerability

The nature and extent of historical and potential avalanche hazards in the Juneau area are described above. For the purposes of the vulnerability assessment, the following resources, listed in order of preference (preference meaning the most comprehensive data available), were utilized to map the extent of avalanche hazard zones in the Juneau area. Data from these sources were divided into high and moderate hazard zones as described below and depicted on Map 7 on page 35:

- Mears and others (1992)[1] provide maps of the Behrends Avenue and White Subdivisions in the northwest part of Juneau, which depict a Zone A (Severe Hazard) and Zone B (Special Engineering Zone {buildings must be specially engineered to be constructed within the hazard zone}) for each of these neighborhoods.
- Fredston and Fesler (1989)[2] completed a map of probable 20-year and 100-year avalanche boundaries for the southeast end of downtown Juneau near the wastewater treatment facility. These zones are included in the high and moderate hazard avalanche categories, respectively, in the vulnerability assessment.
- Two data sources were utilized to map high and moderate avalanche boundaries in areas of Juneau not covered by the two site-specific studies described above. Where the two data sources are not in exact agreement, the more conservative of the two was preferentially chosen for use in the vulnerability assessment:
  - Frutiger (1972)[3] completed a map of high and potential avalanche hazards for the greater downtown Juneau area as part of a broader geophysical hazard investigation.
  - GIS data available from the University of Alaska Southeast (UAS) (2003)[4], based on research by Bill Glude at the Southeast Alaska Avalanche Center, depict high avalanche hazard areas around the north side and northwest end of downtown, as well as southeast of downtown along Thane Road.

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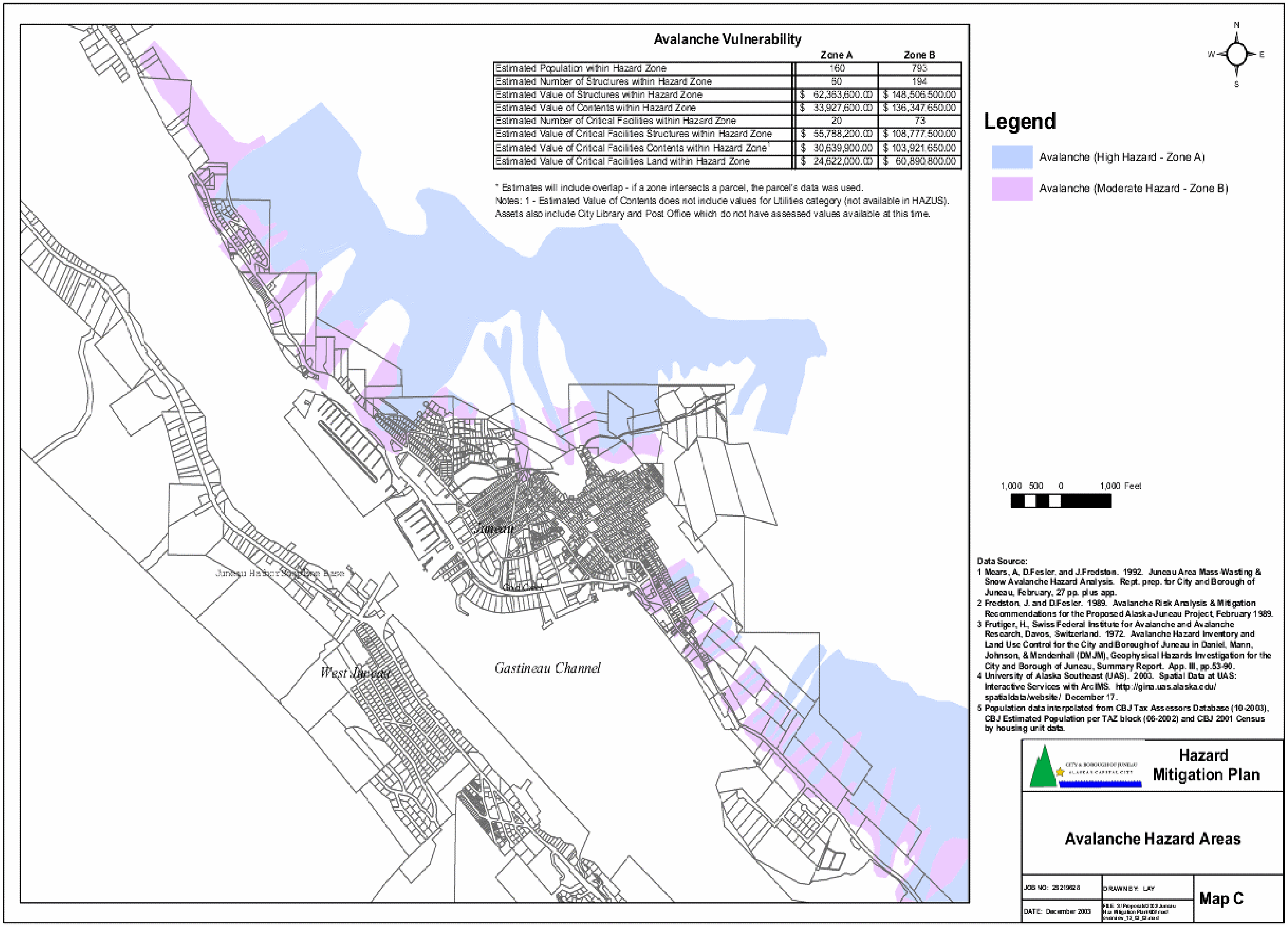
[1] Mears, A., D. Fesler, and J. Fredston. 1992. Juneau Area Mass-Wasting & Snow Avalanche Hazard Analysis. Rept. prep. for City and Borough of Juneau. February. 27 p. plus app.

[2] Fesler, D. and J. Fredston. 1989. Avalanche Risk Analysis & Mitigation Recommendations for the Proposed Alaska-Juneau Project. Rept. prep. for Echo Bay Exploration, Inc. February. 33 p. plus app.

[3] Frutiger, H., Swiss Federal Institute for Avalanche and Avalanche Research, Davos, Switzerland. 1972. Avalanche Hazard Inventory and Land Use Control for the City and Borough of Juneau in Daniel, Mann, Johnson, & Mendenhall (DMJM), Geophysical Hazards Investigation for the City and Borough of Juneau, Summary Report. App. III, pp.53-90.

[4] Frutiger, H., Swiss Federal Institute for Avalanche and Avalanche Research, Davos, Switzerland. 1972. Avalanche Hazard Inventory and Land Use Control for the City and Borough of Juneau in Daniel, Mann, Johnson, & Mendenhall (DMJM), Geophysical Hazards Investigation for the City and Borough of Juneau, Summary Report. App. III, pp.53-90.



Map 7 Avalanche Hazard Areas

Other avalanche information reviewed as part of the vulnerability assessment included maps depicting avalanche and landslide hazards combined into one hazard category, which were developed by the CBJ Planning Department and utilized by Carson Dorn, Inc. (2001)[5] in a recent hazard analysis. These maps were not used in the vulnerability assessment in an effort to provide different loss estimates for avalanches and landslides as separate categories.

Existing Community Assets

Community assets considered in the vulnerability assessment include an inventory of structures, infrastructure facilities, and the contents of structures. Structure and infrastructure values were provided in GIS format by the CBJ Tax Assessor's Office for the downtown area by land parcel. Values of structures were treated independently from property values, which were not included in the loss estimates for avalanche hazards. That is, it was assumed that property without a developed structure would not experience financial loss in the event of an avalanche.

Structure values were obtained from the CBJ tax assessor's database for the following numbers of structures in seven different occupancy classifications: 9,257 residential, 539 commercial, 94 government, 54 utilities, 41 religious or non-profit, 244 industrial, and 17 educational. The value of contents within structures was estimated based on guidelines published by FEMA[6], which provide estimates by structure type as a percentage of overall structural value. For the purpose of the vulnerability assessment, it was assumed that a total loss for both structure and contents would occur in the event of an avalanche.

The values data were queried in the GIS database for parcels that overlap a high and/or moderate avalanche hazard zone. Loss estimates resulting from this inventory are summarized on Map 7 on page 35. Structural losses within the high hazard zones are estimated to total approximately $62 million, while those in the moderate hazard/special engineering zones are estimated to total about $148 million. The estimated value of structure contents totals approximately $34 million in the high hazard zones and $136 million in the moderate hazard zones. These figures include the value of all structures whose parcels overlap a high and/or moderate avalanche hazard zone, including commercial and undeveloped properties.

A 2001 study by the Southeast Alaska Avalanche Center focused solely on residential property values in the Behrends and White Subdivisions that are vulnerable to moderate and/or severe avalanche hazard areas. The approximate value of all residential properties in the Behrends and White moderate and severe hazard zones was approximately $13 million as of 2001, including undeveloped properties.

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[5] Carson Dorn Inc. 2001. Hazard Analysis, City and Borough of Juneau. March. 85 p.

[6] Federal Emergency Management Agency (FEMA). 2001. State and Local Mitigation Planning, How-to Guide for Understanding Your Risks: Identifying Hazards and Estimating Losses, FEMA 386-2. August.

Critical Facilities

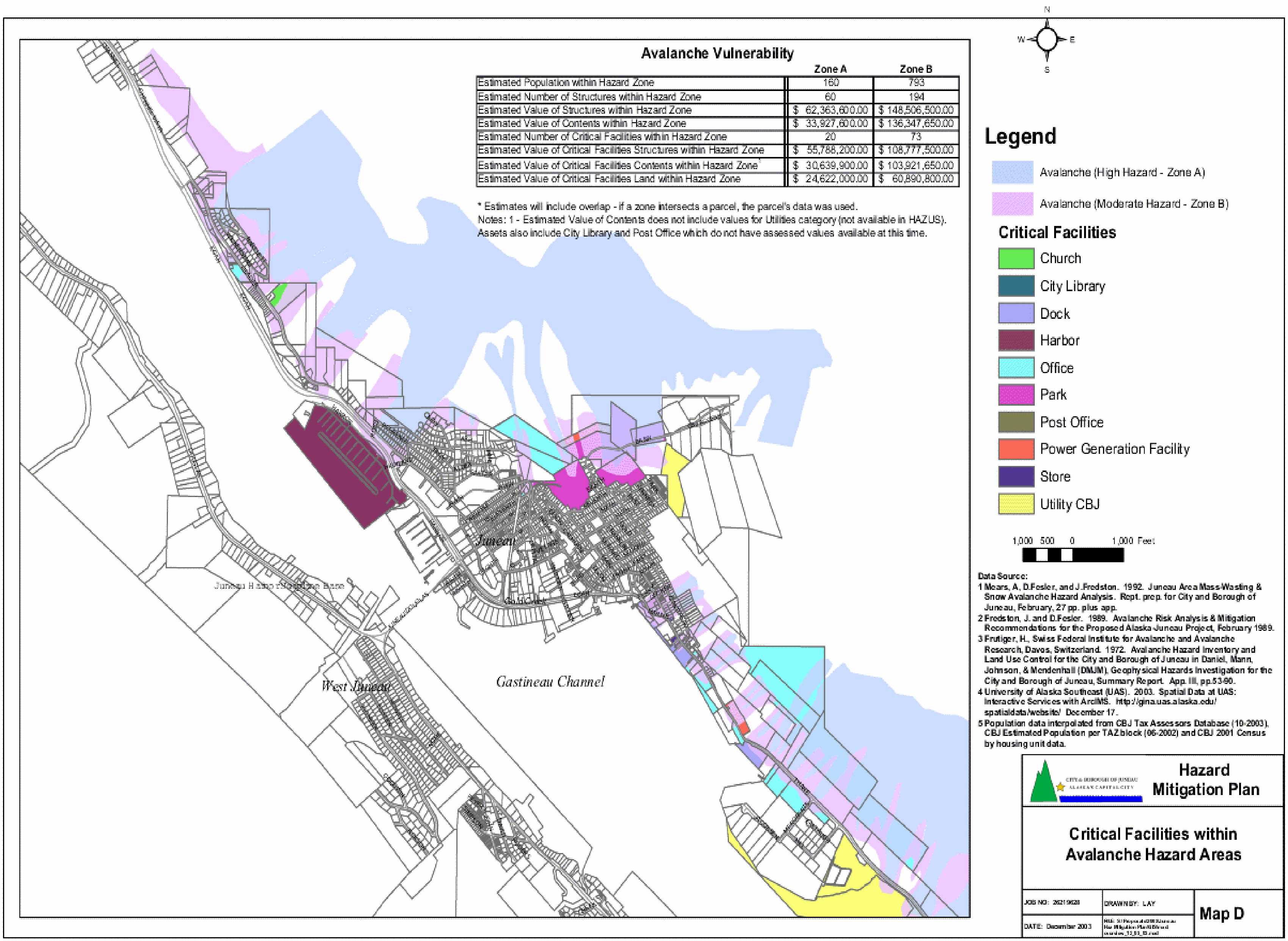
Critical facilities were identified within the high and moderate avalanche hazard zones as a subset of the total community assets. Facilities were designated as critical if they are: (1) vulnerable due to the type of occupant (children, elderly, hospitalized, etc.); (2) critical to the community's ability to function (roads, power generation facilities, water treatment facilities, etc.); (3) have a historic value to the community (cemetery, museum, etc.); or (4) critical to the community in the event of a hazard occurring (police, fire stations, hospitals, emergency operations centers, etc.).

The following types of critical facilities were identified within the high and moderate hazard zones: Churches, City Library, Docks, Harbors, Offices, Parks, a Post Office, Power Generation Facilities, Stores and CBJ Utilities. An inventory of the number of critical facilities in each avalanche hazard zone is detailed below and shown on Map 8 on page 38.

Table 11 Critical Facilities in Avalanche Hazard Zones

Avalanche High Hazard Zone A	Number of Critical Facilities	Avalanche Moderate Hazard Zone B	Number of Critical Facilities
Office	7	Church	1
Park	10	City Library	1
Power Generation Facility	1	Dock	4
CBJ Utility	2	Harbor	3
		Office	36
		Park	8
		Post Office	1
		Power Generation Facility	2
		Store	13
		CBJ Utility	4

The estimated loss of critical facility structures and their contents in the event of an avalanche totals approximately $86 million for the high hazard zones and $213 million for the moderate hazard zones. Table 11 provides a tabulation of the critical facilities estimated loss in the event of an avalanche.



Map 8 Critical Facilities Within Avalanche Hazard Areas

Vulnerable Population

The population of Juneau located within potential avalanche zones was previously estimated by Carson Dorn to be approximately 8,000 people, based on hazard maps depicting a combination of avalanche and landslide hazard zones. Estimates of population loss in this vulnerability assessment are based on avalanche hazard zones only, as well as the following assumptions:

- Average population per parcel was calculated using CBJ population housing type codes (2001 Census data), TAZ codes, and geographic area population estimates. Total population by housing unit was divided by total number of parcels to determine population by parcel.
- Population data was not available for other than residential housing units (unless a commercial or industrial coded parcel had a residential housing unit code applied to it {e.g. COMM/1+AP}).
- Population information is not currently available to assist in identifying the number of persons employed by parcel. For the purposes of this project, it is assumed that approximately 16,700 people are currently employed in the Juneau area (2000 Census data). Based on the locations of offices within each hazard area it is conservatively assumed that 25% (4,175 people) of the employable population could be located within any of the three hazard areas at the time of a hazard event.
- Tourism brings over 800,000 visitors per year to the Juneau area. As it is impossible to predict when a hazard may occur, it is also impossible to predict where visitors may be during an event. For this purposes of this project, it is conservatively assumed that 1% (8,000 people) of the yearly tourist population could be located within any of the hazard areas at the time of a hazard event, based on a peak daily cruise ship visitation of 7,500 and 500 independent visitors.
- The survival rate for persons located within a hazard zone in the event of an avalanche was assumed to be zero.

These data were entered into the GIS database and queried where parcels overlapped the high and moderate avalanche zones. The resulting populations total approximately 160 people in the high hazard zones and 793 in the moderate zones.

Future Development

As outlined in the current CBJ Land Use Code (Chapter 49.70[7]), future development is currently restricted to single-family dwellings within potential and severe avalanche/landslide hazard areas mapped by the CBJ Planning Department. Other types of development require a conditional use permit, and hazard zone boundary changes require a site-specific study.

[7] CBJ. 2001. Land Use, City of Juneau, Alaska. Title 49, Code of Ordinances.

In addition, the current CBJ Comprehensive Plan[8] indicates the following with regard to future development in avalanche/landslide hazard areas: the inclusion of mitigating standards (e.g. dissipating structures) in the Land Use Code for all development within hazard zones; the designation of all public lands within hazard areas as open space; the prohibition of industrial and resource extraction activities within hazard areas unless shown not to increase the hazard; and the elimination of public facilities development plans that could concentrate people in hazard areas.

Thus, existing land use codes and management plans discourage future development in avalanche hazard areas. If future development were to occur within these zones, estimates of vulnerable community assets and population loss would likely increase.

Data Limitations

The results of the vulnerability assessment and loss estimations are limited by the specificity and accuracy of the data, as well as by the assumptions used in the GIS queries. For example, existing avalanche maps vary from general to site-specific, and do not always agree. The most conservative data was generally used in this assessment; however, it is possible the data could be under-conservative in areas without site-specific studies. The map of avalanche zones in Map 7 is not intended to provide a forecast or define the probability of any particular avalanche event and should be used for planning purposes only.

Assumptions used in the querying of GIS data have generally provided results on the conservative side. Value estimates of structures and contents assumed a total loss in the event of an avalanche. Queries were based on parcel boundaries that touch an avalanche zone, not on building centroids, which would be a more accurate method for defining structure loss (building centroids are not currently available in the CBJ database). Parcels only partially within an avalanche hazard zone were included in the loss estimates. There is also some overlap of loss estimates due to some parcels touching both high and moderate zones. Population loss estimates assume all residents are at home at the time of an event, and that there are no survivors.

Lastly, the total of the loss estimates assumes that avalanche events occur in all chutes at the same time or within a short season.

Avalanche Mitigation

Current CBJ Avalanche Mitigation Activities

1. Avalanche Ordinances: The CBJ adopted an avalanche ordinance in 1987 which restricts development in severe avalanche areas to single family houses that are built to withstand avalanche impact loads. In other mapped avalanche areas such as the moderate hazard zone, all development greater than a single family home requires a conditional use permit. However,

[8] CBJ Community Development Department. 1996. Comprehensive Plan of the City & Borough of Juneau, 1995 Update. November. 234 p.

since these ordinances have been in place, there has been some development allowed in these areas through variances granted by the CBJ for small buildings or buildings with limited occupancy. The CBJ General Engineering Division is in charge of enforcing these ordinances.

2. Avalanche hazard investigation and mapping**:** There have been several research and mapping projects regarding the avalanche hazard for the CBJ. Avalanche paths in the CBJ area are well documented through these studies.

- 1967: "Report on the Behrends Avenue Avalanche Path" prepared by Keith Hart
- 1972: "Geophysical Hazards Investigation For the City and Borough of Juneau" prepared by Daniel, Mann, Johnson & Mendenhall
- 1992: "Juneau Area Mass-Wasting and Snow Avalanche Hazard Analysis" prepared by Doug Fesler, Jill Fredston, and Art Mears.
- 2003: "Urban Avalanche Response Plan"(Appendix to CBJ Emergency Operations Plan) prepared by Bill Glude.

3. Avalanche control**:** The Alaska DOT uses a howitzer to control avalanches on Thane Road. Most of the avalanche zones within the CBJ cannot be mitigated against in this way due to the danger to people, property and homes.

CBJ Avalanche Mitigation Ideas

Goal: Reduce the CBJ's vulnerability to avalanche hazards in terms of threat to life and property.

- **Prohibit new construction in avalanche zones**. Construction in avalanche zones means bigger losses in the future should an avalanche occur. New construction in hazard zones should be discouraged or prohibited, even if structures are not intended for habitation.
- **Utilize appropriate methods of structural avalanche control.** Containment structures, depending on their design, can prevent snow loads from releasing and forming an avalanche, and/or protect structures by diverting or containing avalanche debris. Such structures include snow fences, diversion/containment structures, snow nets, and reforestation.
- **Enact buyout of homes in avalanche paths.** A buyout could be implemented to reduce the number of people living in avalanche zones.
- Update existing structures within avalanche zone to avalanche impact standards. Structures that already exist can be made safer with structural reinforcements.

Goal: Promote public education and awareness regarding avalanche hazards.

- **Public education:**
  - *Continue to educate public about avalanche hazard.* Information can be disseminated to the public through the CBJ Web site, press releases, media ads, and other methods.

    - *Promote mitigation plan effort.* The public should be given all possible opportunities to express their concerns and opinions regarding hazards that threaten their community. The mitigation plan effort is an excellent forum to promote public involvement in the planning process and allows residents to stay informed.
    - *Encourage homeowners to undertake mitigation actions for their own homes.* Knowing more about the hazard and how to protect themselves may enable homeowners to undertake their own mitigation measures.

- **Establish regular avalanche hazard evaluation and forecasting during the winter months.** Making residents aware of current avalanche danger will help them make an informed decision whether to evacuate during times of high risk.
- **Attach "high hazard" designation to homes within avalanche zones.** Current disclosure laws require that home buyers be informed regarding the hazards to which a given property is exposed. However, there are no rules regarding how and when the buyer must be told of the hazard. Attaching hazard information to the title or deed to a property will ensure that a new buyer is aware of the hazard.

LANDSLIDES

A landslide is a natural event that causes damage when human activities interface with slide areas. Landslides occur naturally when inherent weaknesses in the rock or soil combine with one or more triggering events such as heavy rain, snowmelt, changes in groundwater level, and seismic or volcanic activity. Erosion that removes material from the base of a slope can also cause naturally triggered landslides. Human activities such as road construction, excavation, and mining can also cause landslides.

Landslides are a significant hazard in Juneau because of the climate, topography, and the presence of other hazards such as earthquakes that might increase the likelihood of a landslide. The possibility of additional hazards caused by landslides compounds the hazard; landslides can trigger tsunamis and flash floods.

Hazard Description and Characterization

Landslide is a generic term for a variety of downslope movements of earth material under the influence of gravity. Some landslides occur rapidly, in mere seconds, while others might take weeks or longer to develop. Landslides usually occur in steep areas. Underwater landslides are also a hazard; usually involve areas of low relief and slope gradients in lakes and reservoirs or in offshore marine setting, and can cause collapse of structures as well as tsunamis.

Human activities that trigger landslides are usually associated with construction such as grading that removes material from the base, loads material at the top, or otherwise alters a slope. Changing drainage patterns, groundwater level, slope and surface water (for example the addition of water to a slope from agricultural or landscape irrigation), roof downspouts, septic-tank effluent, or broken water or sewer lines can also cause landslides. Removal of vegetation from steep slopes can erode the integrity of the ground and lead to landslides.

Three main factors influence landslides: topography, geology and precipitation. Topography and geology are associated with each other; the steeper the slope, the greater the influence from gravity. Rock strength is important as certain bedrock formations or rock types appear to be more prone than others to landslides. Precipitation may erode and undermine slope surfaces. If precipitation is absorbed into the ground, it increases the pore water pressure and lubricates weak zones of rock or soil.

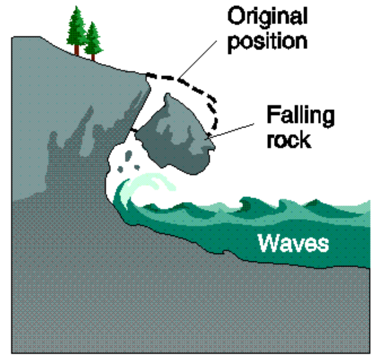
The Juneau area possesses each of these landslide factors in liberal amounts. Steep slopes surround the city, heavy precipitation and saturated soil is common, and bedrock is covered by thick soil cover. Soil creep and flow can be observed throughout the area as topsoil is pulled down slopes by gravity.

Types of Landslides

Landslides are usually classified by type of movement; falls, topples, lateral spreads, slides, and flows. A combination of two or more types is called a complex movement. Each type can be further broken down based on the type of material involved.

Falls

Falls occur when masses of rock or other material detach from a cliff or other steep slope and move downhill by free fall, rolling or bouncing. The movement is very quick. The typical slope angle involved is from 45 to 90 degrees. Rock falls occur when a rock on a steep slope becomes dislodged and falls down the slope. A rock fall may be a single rock or a mass of rocks, and the falling rocks can dislodge other rocks as they collide with the cliff. At the base of most cliffs is an accumulation of fallen material termed *talus***.** Rock falls are a constant hazard along transportation routes through rocky terrain.



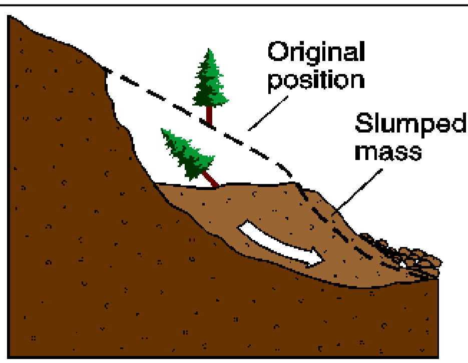
Fall. Image courtesy of *Landslides in British Columbia.*

Debris falls are similar, except they involve a mixture of soil, regolith (unconsolidated weathered rock and soil material), vegetation, and rocks.

Topples

Topples are the forward rotation of rocks or other materials about a pivot point on a hillside. The movement is tilting without collapse but if the mass pivots far enough, a fall may result.

Slides



A Rotational Slide or Slump. Image courtesy of *Landslides in British Columbia.*

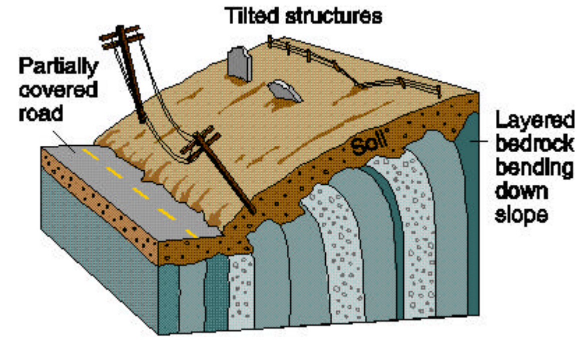
Slides are characterized by shear displacement along one or several surfaces. The two general types of slides are rotational and translational. In a rotational slide, the rupture surface is concave upward, and the mass rotates along the concave shear surface. Rotational slides, also called slumps, can occur in bedrock, debris, or earth. In a translational slide, the rupture surface is a smooth or gently rolling slope. In bedrock and earth, translational slides are sometimes called block slides if an intact mass slides down the slope. If rock fragments or debris slide down a slope on a distinct shear plane, the movements are called rockslides or debris slides.

Lateral Spreads

Lateral spreads involve the horizontal displacement of the surface. They often occur on gentle slops that range between 0.3° and 3°. Lateral spreads can occur in rock but this process is not well documented and movement rates can be quite slow. They are more common in fine-grained soils, such as clay, especially if the soil has been remodeled or disturbed by construction, grading or similar activities. Loose granular soils commonly produce lateral spreads through liquefaction (where saturated soils are transformed from a solid into a liquefied state). Liquefaction can occur spontaneously because of changes in pore-water pressure or in response to vibrations such as those produced by seismic activity. Lateral spreads typically damage pipelines, utilities, bridges, and other structures having shallow foundations.

Flows/Soil Creep

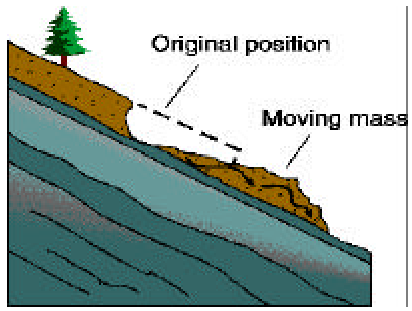
In general, a flow is a moving mass that has differential internal movements that are distributed throughout the mass. They differ from slides by their higher water content and the distribution of velocities that resembles a viscous fluid.



Creep. Image courtesy of *Landslides in British Columbia.*

Soil creep is an imperceptibly slow, steady downward movement of slope-forming soil or rock due to gravity. Creep can occur due to alternate wetting and drying which expands and contracts the ground. Evidence of soil creep can be observed throughout the Juneau area; forests are full of trees with bent trunks which indicate long-term soil creep.

A debris flow is a rapid movement of loose soil, rock and organic matter combined with water and air to form a downward moving slurry. The slurry can travel several miles from its source, growing in size as it picks up trees, cars, and other materials along the way.



Flow. Image courtesy of *Landslides in British Columbia.*

Debris flows tend to occur on slopes in the 20-45 degree range, like those that surround Juneau. They are usually associated with unusually heavy precipitation or with rapid snowmelt. They can also occur following the bursting of a natural dam formed by landslide debris, glacial moraine, or glacier ice.

Additional Causes and Secondary Effects

Landslides are often associated with other hazards. For example, a landslide may occur during floods because both involve precipitation, runoff, and ground saturation. Landslides are also often associated with seismic and volcanic events. Some of the costliest landslides in American history were caused by the 1964 Good Friday earthquake. It has been estimated that ground failure caused about 60% of the damage.

The secondary effects of landslides can also be very destructive. Landslide-caused dams cause damage upstream due to flooding and downstream due to a flood which may develop as a result of a sudden dam break. Landslides can also cause tsunamis and seiches when slide material slides into a lake or sea, displacing large amounts of water.

Areas most vulnerable are deep bays and inlets adjacent to steep slopes, such as those that surround Juneau. In these semi-enclosed basins, the water can oscillate to create a large wave, called a seiche, which can impact the shorelines several times before dissipating. The waves that destroyed much of old Valdez after the great 1964 earthquake were caused by an earthquake-triggered submarine slide. In 1958, an earthquake on the Fairweather fault triggered a large landslide that crashed into the head of Lituya Bay, generating a wave that stripped trees to an elevation of 1,700 ft. on the opposite shoreline. A non-earthquake related seiche occurred in Skagway Harbor in November 1994, destroying part of the state ferry dock and city boat harbor. This seiche was caused by a submarine landslide, which apparently was triggered by an extreme low tide.

There may be many similar unstable areas around Juneau where damaging landslide-generated waves can occur as a result of earthquakes or other triggering events. Vertical seafloor motion resulting from a future earthquake in the Yakataga seismic gap could produce a damaging tsunami.

Local Landslide Hazard Identification

Landslide Classifications and Terminology

Landslide Probability

Historically, the largest and most destructive landslides have been associated with more than 1.5 inches of rain in a 24-hour period. Precipitation records indicate that precipitation intensities of 2.0 inches in 24 hours can be expected at return periods of 5-10 years. Therefore, the conditions necessary for production of large landslides continue to prevail today even though major, destructive landslides do not occur frequently.

Landslide Hazard Classifications

Severe Hazard Areas have the following characteristics:

a. Velocities may reach 15-30 feet per second (10-20 mph)
b. Flow depths may be 5 feet or more
c. Impact pressures over the entire flow depth may exceed 1000 lbs/ft2
d. Depositional loads on exposed horizontal surfaces may reach 1000 lbs/ft2
e. Normal (wood-frame construction will be severely damaged or destroyed by impact and depositional loading
f. Structural mitigation is possible with careful study, design, and construction methods, but reinforcement of wood-frame buildings may not be possible

Special Engineering Areas have the following characteristics:

a. Velocities will generally be less than 15 ft/sec (approx. 10 mph)

b. Flow depths will be less than 5 feet
c. Impact pressures will range from 100 to 1000 lbs/ft^2
d. Depositional loads on exposed horizontal surfaces will be less than 1000 lbs/ft^2
e. Normal wood-frame construction can be severely damaged or destroyed by impact, crushing, relocation, or flooding
f. Structural mitigation is possible at special engineering sites and can be used in typical cases to protect objects

Juneau landslide paths and danger zones

Many of Juneau's landslide paths coincide with avalanche paths. There are additional areas of concern, however, such as the area above Gastineau Avenue and between Gastineau Avenue and South Franklin Street. Unmapped areas within the borough remain to be studied for landslide hazards, and will be included in this plan as resources become available to evaluate those areas for landslide hazards.

Juneau's Landslide History

January 2, 1920
A series of debris avalanches occurred in the area between Gastineau Avenue and South Franklin Street. Damage was caused by the impact of the debris slides as well as the relocation of several buildings, which slid into other buildings. Four people were killed, and up to eight were injured.

Debris on South Franklin Street following landslide of November 22, 1936.

November 15, 1929
Gastineau Avenue landslide destroyed one home.

October 16 1936
A debris avalanche between Gastineau Avenue and South Franklin Street destroyed several buildings and buries one resident.

November 22, 1936
One of Juneau's most destructive landslides occurred on November 22, 1936. Prolonged heavy rainfall triggered a debris flow that struck a residential area causing numerous injuries and deaths. The slide completely covered South Franklin Street to a depth of approximately ten feet. Fifteen people were killed.

July 16, 1984
Heavy rain fell on already waterlogged soils and triggered a debris avalanche/flow that destroyed a small hydroelectric dam, damaged two houses and left debris on the Glacier Highway and inside several local businesses.

October 20, 1998
Over the 19th and 20th of October, over six inches of rain fell in the Juneau area, saturating the soil and causing several ground failures, closing several sections of highway and damaging homes, roads, and state trails. Slides occurred along North Douglas Highway, on Thane Road, downtown near Cope Park, and along Glacier Highway in several locations just north of the high school, in the Twin Lakes area, and near the ferry terminal. At least 5 homes were damaged on North Douglas due to mass wasting and flooding between Cordova Street and the Bonnie Brae subdivision. After the slides occurred along Glacier Highway, the AWARE women's shelter was flooded with muddy water. Another mud slide completely collapsed a section of Fritz Cove Road (just north of the airport) and removed a beachfront home from its foundation. The home was completely destroyed [9].

Landslide Hazards Summary

Potential Damage

- Damage/destruction of structures
- Transportation Interruption
- Power interruption
- Lack of access to services (hospital, emergency services, etc)

Impacts to Humans

- Impact/crushing injuries
- displaced people/lack of shelter
- loss of life
- property loss

Structure damage from the slide of January 2, 1920, above South Franklin Street.

[9] http://testaprfc.arh.noaa.gov/pubs/newsltr/pub6/SE_flood.html

Local Landslide Vulnerability

Extent of Vulnerable Zones

The nature and history of landslide hazards in the Juneau area are described above. For the purposes of the vulnerability assessment, the following resources, listed in order of preference (preference meaning the most comprehensive data available), were utilized to map the extent of landslide hazard zones in the Juneau area. Data from these sources was divided into high and moderate hazard zones as described below and depicted on Map 9 on page 50.

Mears and others (1992)[10] provide maps of the White Subdivision, Behrends Avenue area, and the southeast side of downtown Juneau, which depict a Severe Hazard (Zone A) and a Special Engineering Zone (buildings must be specially engineered to be constructed within the hazard zone) (Zone B) for each of these neighborhoods.

Swanston (1972)[11] completed a map of high and potential mass wasting hazards for the greater downtown Juneau area as part of broader geophysical hazard investigation. This map incorporates data regarding unstable slope angles, historic landslide deposits, mass wasting channels, and rock slide areas. These data were used to map high and moderate landslide boundaries in areas of Juneau not covered by the site-specific study described above. Where the two data sources are not in exact agreement, the more conservative of the two was preferentially chosen for use in the vulnerability assessment.

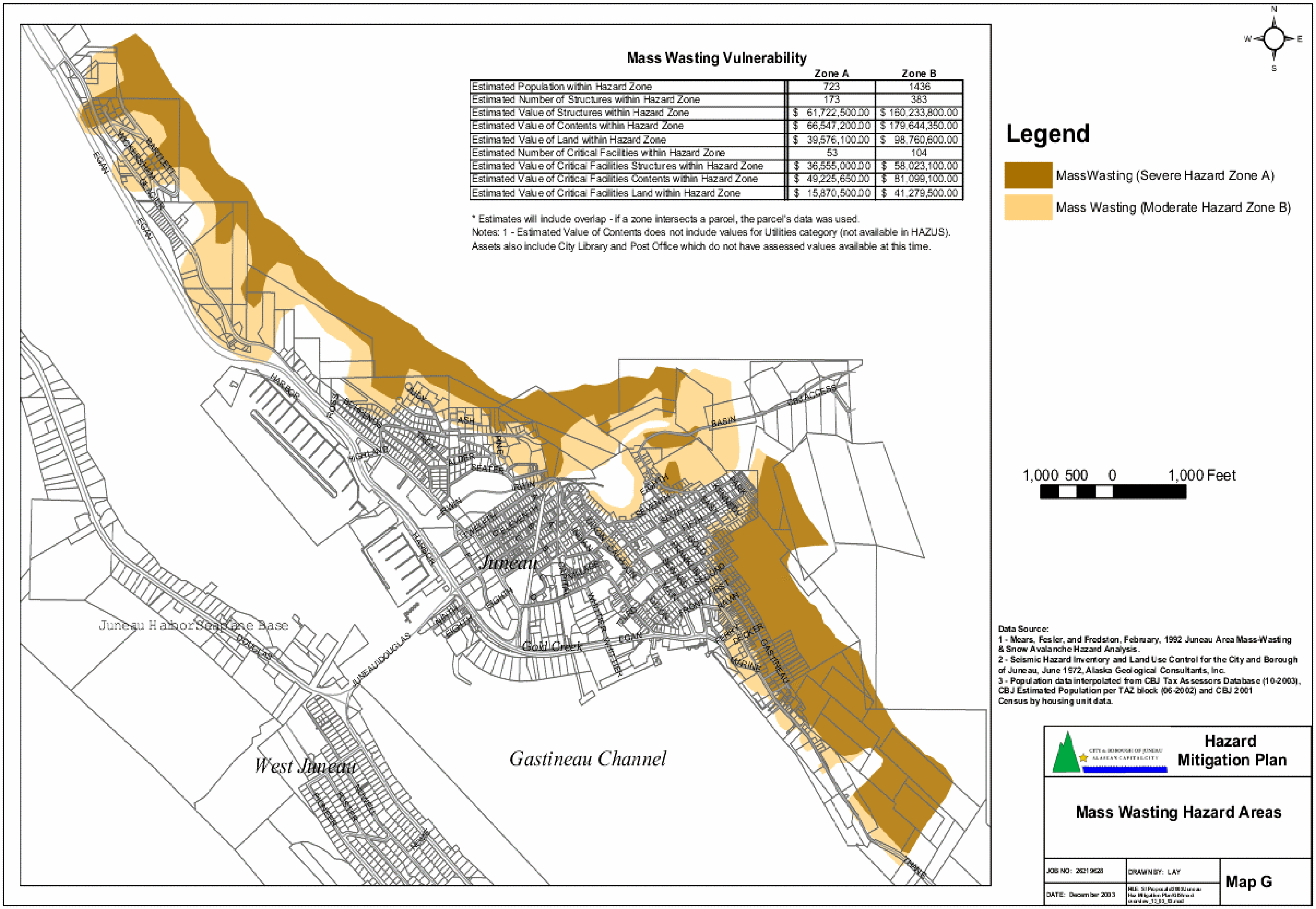

January 2, 1920 landslide damage, looking down from Gastineau Avenue.

Other landslide information reviewed as part of the vulnerability assessment included maps depicting avalanche and landslide hazards combined into one hazard category, which were developed by the CBJ Planning Department and utilized by Carson Dorn, Inc. (2001)[12] in a recent hazard analysis. These maps were not used in the vulnerability assessment in an effort to provide different loss estimates for landslides and avalanches as separate categories.

[10] Fesler, Fredston, and Mears. 1992. Juneau Area Mass-Wasting and Snow Avalanche Hazard Analysis. Rept.prep. for City and Borough of Juneau. February. 27 p. plus app.

[11] Swanston, D.M., U.S. Forest Service, Forest Services Laboratory, Corvallis, Oregon. 1972. Mass Wasting Hazard Inventory and Land Use Control for the City and Borough of Juneau in Daniel, Mann, Johnson, & Mendenhall (DMJM), Geophysical Hazards Investigation for the City and Borough of Juneau, Summary Report. App. II, pp.17-51.

[12] Carson Dorn Inc. 2001. Hazard Analysis, City and Borough of Juneau. March. 85 p.



Mass Wasting Vulnerability

	Zone A	Zone B
Estimated Population within Hazard Zone	723	1436
Estimated Number of Structures within Hazard Zone	173	383
Estimated Value of Structures within Hazard Zone	$ 61,722,500.00	$ 160,233,800.00
Estimated Value of Contents within Hazard Zone	$ 66,547,200.00	$ 179,644,350.00
Estimated Value of Land within Hazard Zone	$ 39,576,100.00	$ 98,760,600.00
Estimated Number of Critical Facilities within Hazard Zone	53	104
Estimated Value of Critical Facilities Structures within Hazard Zone	$ 36,555,000.00	$ 58,023,100.00
Estimated Value of Critical Facilities Contents within Hazard Zone	$ 49,225,650.00	$ 81,099,100.00
Estimated Value of Critical Facilities Land within Hazard Zone	$ 15,870,500.00	$ 41,279,500.00

* Estimates will include overlap - if a zone intersects a parcel, the parcel's data was used.
Notes: 1 - Estimated Value of Contents does not include values for Utilities category (not available in HAZUS).
Assets also include City Library and Post Office which do not have assessed values available at this time.

Map 9 Mass Wasting Hazard Areas

Existing Community Assets

Community assets considered in the vulnerability assessment included an inventory of structures, infrastructure facilities, and the contents of structures. Structure and infrastructure values were provided in GIS format by CBJ for the downtown area by land parcel. Structure value and property value were treated as separate categories in the loss estimates, as it was assumed that property without a developed structure could still experience financial loss in the event of a landslide (e.g. landslides and other types of erosion cause actual loss of property due to the potential of the property sloughing off into a water body).

Structure values were obtained from the CBJ tax assessors' database for the following numbers of structures in seven different occupancy classifications: 9,257 residential, 539 commercial, 94 government, 54 utilities, 41 religious or non-profit, 244 industrial, and 17 educational. The value of contents within structures was estimated based on guidelines published by FEMA[13], which provide estimates by structure type as a percentage of overall structural value. For the purpose of the vulnerability assessment, it was assumed that a total loss for structure, land, and contents would occur in the event of a landslide.

The values data were queried in the GIS database for parcels that overlap a high and/or moderate landslide hazard zone. Loss estimates resulting from this inventory are on Map 9. Structural losses within the high hazard zones are estimated to total approximately $62 million, while those in the moderate hazard/special engineering zones are estimated to total about $160 million. The estimated value of land alone is approximately $40 million in the high hazard zones and $99 million in the moderate zones. The estimated value of the contents of structures is about $67 million in the high hazard zones and $180 million in the moderate zones.

Critical Facilities

Critical facilities were identified within the high and moderate landslide hazard zones as a subset of total community assets. Facilities were designated as critical if they are: (1) vulnerable due to the type of occupant (children, elderly, hospitalized, etc.); (2) critical to the community's ability to function (roads, power generation facilities, water treatment facilities, etc.); (3) have a historic value to the community (cemetery, museum, etc.); or (4) critical to the community in the event of a disaster (police, fire stations, hospitals, emergency operations centers, etc.).

The following types of critical facilities were identified within the high and moderate hazard zones: Churches, the City Library, Docks, Offices, Parks, the Post Office, Power Generation Facilities, Stores and CBJ Utilities. Land parcels with critical facilities were queried in the GIS database separately from the total community assets inventory, and the results are listed below and on Map 8 and
Table *12*. The estimated loss of critical facility structures and their contents in the event of a landslide totals approximately $86 million for the high hazard zones and $140 million for the moderate hazard zones.

[13] Federal Emergency Management Agency (FEMA). 2001. State and Local Mitigation Planning, How-to Guide for Understanding Your Risks: Identifying Hazards and Estimating Losses, FEMA 386-2. August.

Table 12 Critical Facilities in Landslide Zones

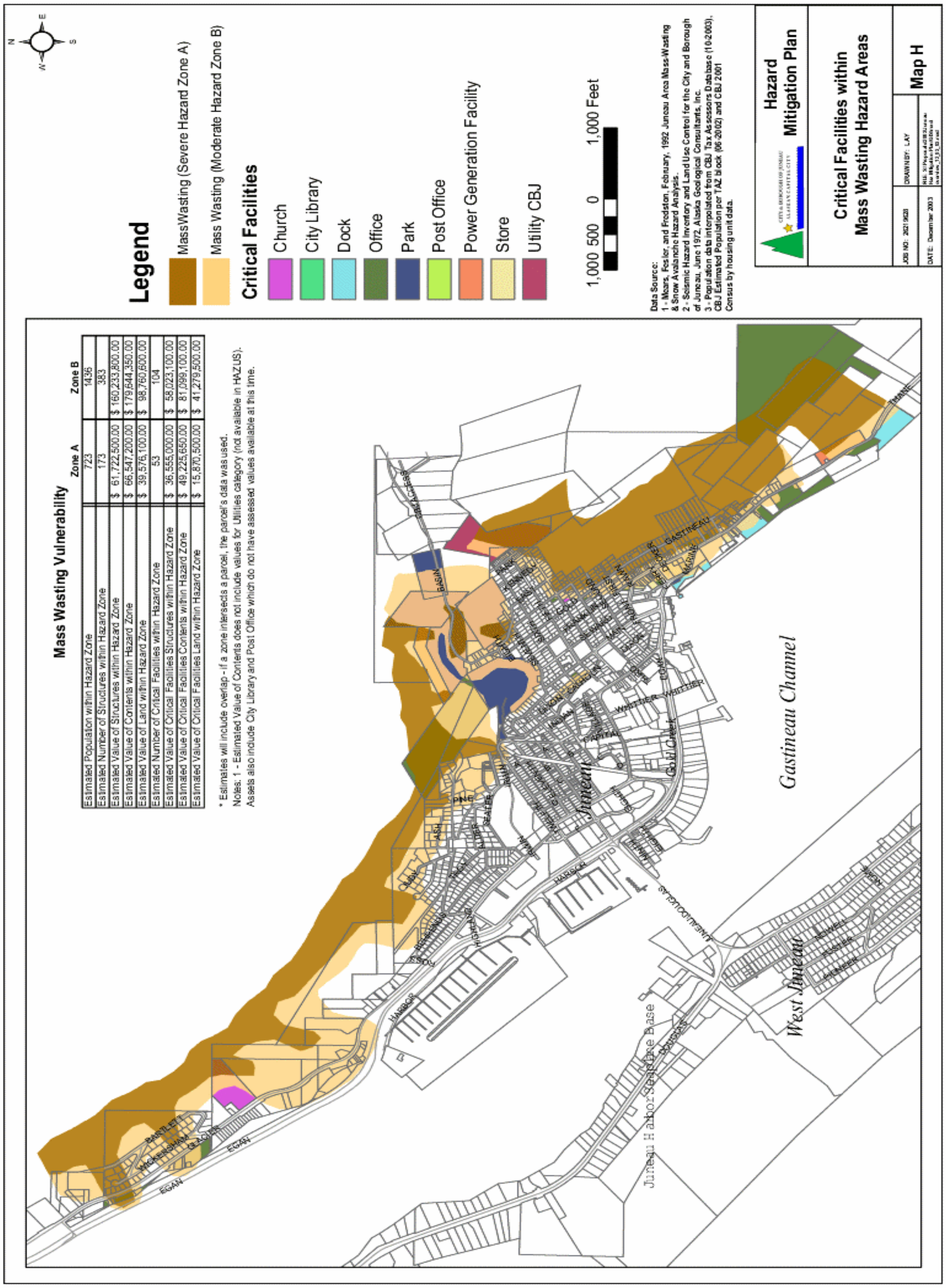
Mass Wasting (Severe Hazard Zone A)	Number of Critical Facilities	Mass Wasting (Moderate Hazard Zone B)	Number of Critical Facilities
Church	1	Church	2
Office	28	City Library	1
Park	5	Dock	3
Power Generation Facility	3	Office	48
Store	14	Park	16
Utility CBJ	2	Post Office	1
		Power Generation Facility	3
		Store	28
		Utility CBJ	2

Vulnerable Population

Estimates of population loss in the event of landslides are based on the following assumptions:

- Average population per parcel was calculated using CBJ population housing type codes (2001 Census data), TAZ codes, and geographic area population estimates. Total population by housing unit was divided by total number of parcels to determine population by parcel.
- Population data was not available for other than residential housing units (unless a commercial or industrial coded parcel had a residential housing unit code applied to it {COMM/1+AP}).
- Population information is not currently available to assist in identifying the number of persons employed by parcel. For the purposes of this project, it is assumed that approximately 16,700 people are currently employed in the Juneau area (2000 Census data). Based on the locations of offices within each hazard area it is conservatively assumed that 25% (4,175 people) of the employable population could be located within any of the three hazard areas at the time of a hazard event.
- As described in Section 2 of this plan, tourism brings over 800,000 visitors per year to the Juneau area. As it is impossible to predict when a hazard may occur, it is also impossible to predict where visitors may be during an event. For this purposes of this project, it is conservatively assumed that 1% (8,000 people) of the yearly tourist population could be located within any of the three hazard areas at the time of a hazard event.
- The survival rate for persons located within a hazard zone in the event of a landslide was assumed to be zero.

These data were entered into the GIS database and queried where parcels overlapped the high and moderate landslide zones. The resulting populations total approximately 723 people in the high hazard zones and 1436 in the moderate zones as depicted on Map 9 on page 50.



Map 10 Critical Facilities Within Mass Wasting Hazard Zones

Future Development

As outlined in the current CBJ Land Use Code (Chapter 49.70), future development is currently restricted to single-family dwellings within potential and severe avalanche/landslide hazard areas mapped by the CBJ Planning Department. Other types of development require a conditional use permit, and hazard zone boundary changes require a site-specific study.

In addition, the current CBJ Comprehensive Plan indicates the following with regard to future development in avalanche/landslide hazard areas: the inclusion of mitigating standards (e.g. appropriate structural engineering) in the Land Use Code for all development within hazard zones; the designation of all public lands within hazard areas as open space; the prohibition of industrial and resource extraction activities within hazard areas unless shown not to increase the hazard; and the elimination of public facilities development plans that could concentrate people in hazard areas.

Thus, existing land use codes and management plans discourage future development in landslide hazard areas. If future development were to occur within these zones, estimates of vulnerable community assets and population loss would likely increase.

Data Limitations

The results of the vulnerability assessment and loss estimations are limited by the specificity and accuracy of the data, as well as by the assumptions used in the GIS queries. For example, existing landslide maps vary from general to site-specific, and do not always agree. The most conservative data were generally used in this assessment. It is possible that they could be either over- or under-conservative in areas without site-specific studies. The maps of mass wasting zones in Maps 9 and 10 are not intended to define the probability of any particular landslide event and should be used for planning purposes only.

Assumptions used in the querying of GIS data have generally provided results on the conservative side. Value estimates of structures and contents assume a total loss in the event of a landslide. Queries were based on parcel boundaries that touch a landslide zone, not on building centroids, which would be a more accurate method for defining structure loss (building centroids are not available in the CBJ database.) Parcels only partially within a landslide hazard zone were included in the loss estimates. There is also some overlap of loss estimates due to some parcels touching both high and moderate zones. Population loss estimates assume all of the population would be lost at the time of an event

Lastly, the total of the loss estimates assumes that landslide events occur in all hazard zones at the same time or within a short season.

Landslide Mitigation

<u>Current CBJ Landslide Mitigation Programs</u>

1. Landslide investigation and mapping:

- 1972: "Geophysical Hazards Investigation For the City and Borough of Juneau" prepared by Daniel, Mann, Johnson & Mendenhall.
- 1992: "Juneau Area Mass-Wasting and Snow Avalanche Hazard Analysis" prepared by Doug Fesler, Jill Fredston, and Art Mears.

2. Landslide ordinance. A hillside ordinance was adopted in 1987 in part to ensure that hillside development provides erosion and drainage control and to minimize damage from hazards in hillside development. It provides standards for approving development in hillside areas, and development in these areas must also provide erosion and drainage controls. Since the ordinance was passed, there has been new development within landslide hazard areas. Variances have been granted to allow small buildings and buildings with limited occupancy to be constructed without meeting landslide-resistance standards or codes regulating the load capacity they are able to withstand. However, such buildings do have to comply with other standards for hillside development. Any new building must undergo an engineering analysis to show that it is built to withstand impact loads appropriate to its location.

3. Landslide-resistant construction. Several buildings in the CBJ have landslide-resistant construction, such as breakaway, sacrificial walls on the lower floors to let landslides pass through (Marine View Building). Other buildings have elevated construction to allow landslides to pass under the bulk of the building.

<u>CBJ Landslide Mitigation Ideas</u>

Goal: Reduce risk of landslides in developed areas.

- **Prohibit removal of vegetation in areas prone to landslides**. Removal of vegetation from slopes can compromise the integrity of the soil and lead to landslides. Requests to remove vegetation should be handled through a permit process that involves an assessment of the area for landslide hazard.
- **Maintain existing drainage system above Gastineau Avenue.** A drainage system above Gastineau Avenue currently exists, but there has been some disparity in determining who is responsible for maintaining it. If the system is adequate, it would benefit the CBJ to maintain the system to a useable standard.
- **Create new drainage systems in appropriate areas.** Drainage systems allow runoff water to drain quickly from the hillsides before it can saturate the soil and subsequently destabilize slopes.

- **Structural reinforcement of unstable slopes.** Structural reinforcement, where appropriate, can help anchor and stabilize areas prone to landslides. Methods of structural reinforcement include fences, barriers, and revegetation.

Goal: Reduce the CBJ's vulnerability to landslide damage in terms of loss of life and property.

- **Buy out property in affected areas**. A buyout could be implemented to reduce the number of people living in avalanche zones.
- **Building code updates**. Require affected properties to retrofit to highest standard of landslide protection.
- **Disallow any new construction in landslide prone areas**. New construction should not be permitted in known hazard areas. Future disaster damages may be avoided by implementing this policy.

Goal: Have comprehensive information regarding landslide hazards and unstable soils throughout the CBJ's developed area, including areas that will be developed in the future.

- Conduct additional study of unstable soils and landslide prone areas, specifically those areas that have not yet been studied and might present additional dangers in the form of underwater landslides, or landslides that may cause tsunamis.

Goal: Increase public awareness of landslide dangers and hazard zones.

- **Public disclosure of risk linked to deed or title of property and require owners to notify renters of hazard prior to occupancy.** Many residents, especially renters, are not aware of the locations of landslide zones or the potential dangers inherent in living within them.
- **Install warning signage in mapped landslide zones.**

FIRE IN DOWNTOWN JUNEAU

Downtown Juneau contains several areas comprised of predominately older wooden structures in close proximity to each other with inadequate structural fireproofing. Large areas of downtown have been designated "high hazard areas" due to the possibility of a conflagration. Prevailing high winds coming from the south compound the problem as do the significant numbers of homes built on the hillside with no defensible space and few escape routes.

A fire downtown coupled with southerly winds could be catastrophic. The winds could push the fire through downtown while the rising heat from the fire would pre-heat the hillside fuels (vegetation and houses) and make them ignite more quickly. Such an event would cause the loss of significant property and commerce, destroy historic buildings, and may cause loss of lives.

Hazard Description and Characterization

Fire cause

Causes of structural fires vary. Cooking, fireplaces, candles, space heaters, cigarettes, lamps, and electrical wiring are all examples of how a structure fire may start. Smoking is the leading cause of fatal fires, and cooking is the leading cause of residential fires. Because fires are avoidable, Fire Prevention is a major focus of fire departments, as the best way to prevent fire damage is to prevent fire itself.

Fires in the wildland-urban interface are of particular concern because they are difficult to control. A structure fire can quickly ignite surrounding vegetation resulting in quick fire spread to nearby structures and vegetation. Urban fire spread is no less a concern; without the application of aggressive fire suppression and protection of exposures, fires do not confine themselves to one building and can easily spread to other buildings. Well-known urban conflagrations include the Peshtigo and Chicago Fires of October 8, 1871 (coincidentally occurring at the same date and time), the San Francisco fires after the earthquake of 1906, and the Oakland firestorm of 1991.

Structural Fire Spread

Most fires start in the contents of a building. For example, a smoldering cigarette may start a fire in a garbage can, stuffed chair or mattress. If the flames are not quickly extinguished while still in the content phase, they will extend throughout the structure. Fire spreads throughout concealed spaces, walls, common roof or attic spaces; and sometimes even along the outside of the building.

Types of construction

Thank you to Vincent Dunn for allowing the CBJ to utilize the following information from his "Structural Fire Spread" article; available on the Internet at http://vincentdunn.com/dunn/newsletters/april/FDNYHP_12.html.

There are five basic groups of building construction used throughout the United States. All buildings in America can be associated with one of the five basic types of construction, identified by Roman numerals in building codes and by engineering schools throughout the nation and listed in order from least combustible to most combustible:

Type I (fire resistive) - Least combustible
Type II (non-combustible)
Type III (ordinary)
Type IV (heavy timber)
Type V (wood frame) -Most combustible

Fire-resistive construction (type I) was originally designed to contain fire inside the building to one floor. This concrete and steel structure, called "fire resistive" when first built at the turn of the century, was supposed to confine a fire with its construction. Faults in modern construction allow fire to spread over several floors in a fire-resistive building despite its steel-and-concrete structure by spreading through air-conditioning and heating ducts as well as from lower windows to windows above in a multi-story building.

Non-combustible (type II) buildings have steel or concrete walls, floors, and structural framework. When a fire occurs inside a type II building, flames rising to the underside of the steel roof deck may conduct heat through the metal and ignite the combustible roof.

Ordinary construction (type III) is also called brick-and-joist construction. It has masonry-bearing walls but the floors, structural framework and roof are made of wood or other combustible material. Ordinary construction has been described by some firefighters as a "lumberyard enclosed by four brick walls."

Heavy-timber (type IV) construction is sometimes called "mill construction" because it was the type of structure used at the turn of the century to house textile mills. These buildings have masonry walls like type III buildings, but the interior wood consists of large timbers that can create large radiated heat waves after the windows break during a blaze. A fire in a heavy-timber building can produce a tremendous conflagration with flames coming out of the windows , spreading fire to adjoining buildings.

Wood-frame (type V) construction is the most combustible of the five building types. The interior framing and exterior walls may be wood. A wood-frame building is the only one of the five types of construction that has combustible exterior walls.

Local Fire Hazard Identification

Juneau area fire history

Structure fires are a constant threat to the Juneau area. Juneau itself has somehow avoided a conflagration even in the town's infancy, but neighboring Douglas has been severely damaged by fire three times:

- March 9, 1911 - a large fire destroyed sixteen buildings in the Douglas business district;
- October 10, 1926 - the eastern side of town, the Indian village, and the small mining town of Treadwell were leveled by fire; and
- February 23, 1937 - another fire destroyed most of Douglas.

Side-by-side wooden buildings made structure fires difficult to control. Many of these types of buildings still stand in Juneau, making the town an interesting historical site but also bearing a significant fire hazard. *Juneau's Historic Neighborhoods* refers to fires in Juneau as "town-eating fires . . . a constant danger in communities where wooden buildings were hastily erected side by side in the land-hungry early days." Although fires did occur in Juneau's downtown area, luckily they were all confined to the building of origin and did not spread. "Today 48 historic buildings are the core and character that define Alaska's modern capital city,"[14] but those buildings are also the primary source of the downtown fire hazard.

Juneau's Vulnerable Areas

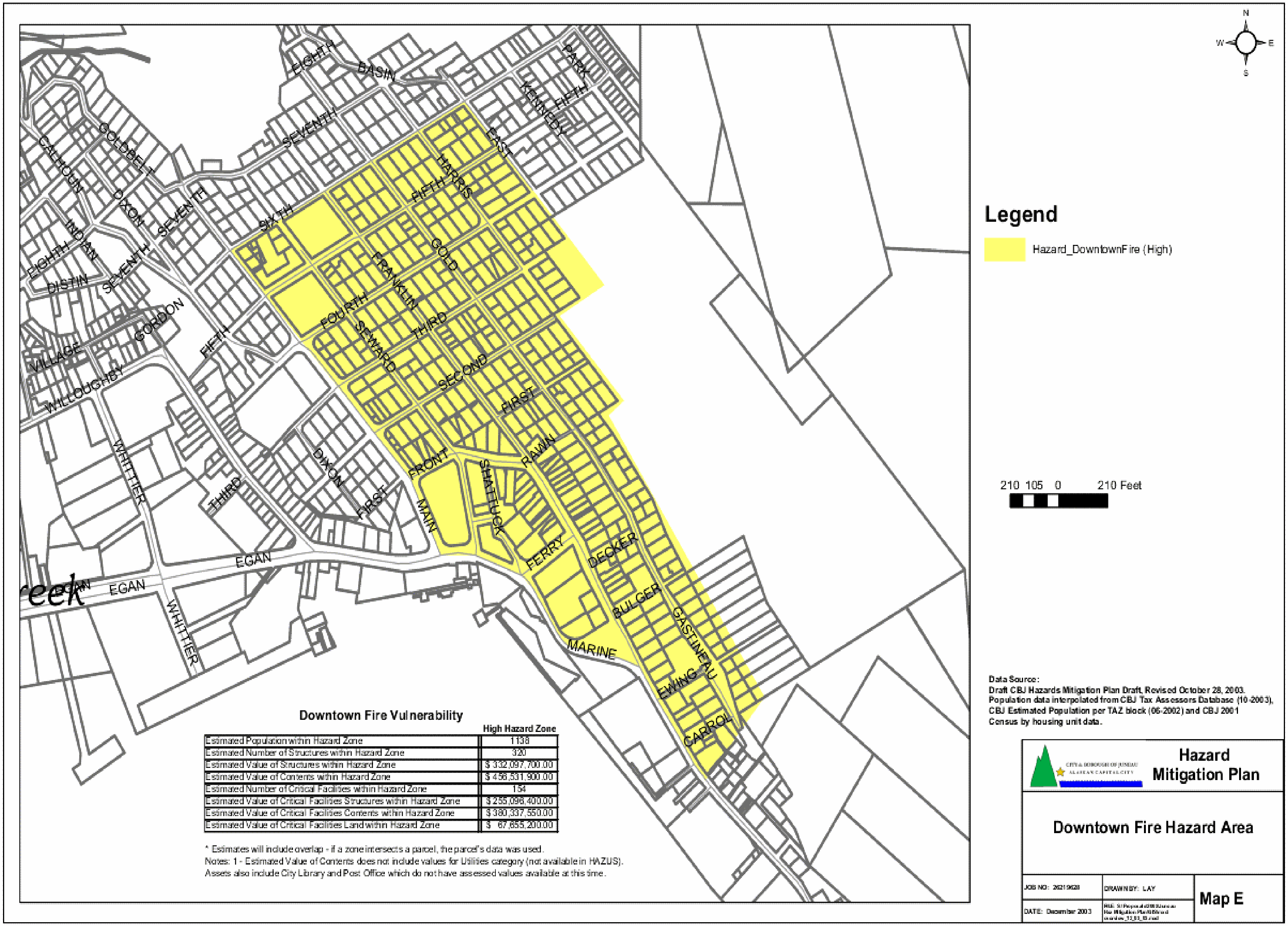
A multi-structure conflagration is of great concern for Juneau because of the high vulnerability of the downtown area. Downtown Juneau contains several areas comprised of predominately older wooden structures in close proximity to each other with inadequate structural fireproofing. The hazard areas are described below:

High Hazard Area

The area between Main Street and Gastineau Avenue as far north as Sixth Street and south along Thane Road to the base of the Tram has been designated a High Fire Hazard Area. Buildings in this area are primarily Type V(wood-frame) construction and many of them are built directly upon creosote-coated pilings. Transient camps dot the hillside as do abandoned buildings. Prevailing winds are out of the south and blow directly from the area of highest hazard towards the rest of the city.

Older wooden structures in the high hazard area.

[14] Foster, Scott. (ed). *Juneau's Historical Neighborhoods*. City and Borough of Juneau Community Development Department.



	High Hazard Zone
Estimated Population within Hazard Zone	1138
Estimated Number of Structures within Hazard Zone	320
Estimated Value of Structures within Hazard Zone	$ 332,097,700.00
Estimated Value of Contents within Hazard Zone	$ 456,531,900.00
Estimated Number of Critical Facilities within Hazard Zone	154
Estimated Value of Critical Facilities Structures within Hazard Zone	$ 255,096,400.00
Estimated Value of Critical Facilities Contents within Hazard Zone	$ 380,337,550.00
Estimated Value of Critical Facilities Land within Hazard Zone	$ 67,855,200.00

* Estimates will include overlap - if a zone intersects a parcel, the parcel's data was used.
Notes: 1 - Estimated Value of Contents does not include values for Utilities category (not available in HAZUS).
Assets also include City Library and Post Office which do not have assessed values available at this time.

Map 11 Downtown Fire Hazard Area

The majority of the area in downtown Juneau is identified as Mixed Use/High Density Residential. High-density residential usage is restricted to 60 residential units per acre. These units can be combined within a single building.

The areas to the northeast of Gastineau and northwest of 5th Street are generally identified as Medium Density Residential. This classification includes residential land for multifamily dwelling units at densities ranging from 7 to 70 units per acre. It also may include subdivisions of mobile home parks when specifically permitted.

The daytime population of this area, which encompasses the cruise ship docks as well as the majority of tourist shops and restaurants, swells exponentially in the summer months. Buildings in this area are very close together and often share walls. Few have sprinkler systems.

Residents of this area have limited egress options should a large fire start. Traffic congestion is common over the entire area, with room for only one way traffic on most roads. Gastineau Avenue, the heavily wooded street approximately 200 feet up the hillside from South Franklin, is a dead end street with only one way in or out. It is a very narrow street with a significant parking problem and it is unlikely that residents would be able to flee a fire in their cars.

Firefighting Assets

Complicating response to a downtown fire is the relatively small number of fire department personnel. Capital City Fire and Rescue (CCFR) currently has 32 career personnel, which is adequate for daily call volumes but will be sorely taxed when called upon to control a large downtown fire. Fifty volunteer firefighters, when available, also respond on-call to emergencies.

Urban Fire Hazard Summary

Potential Damage
- Structures destroyed
- Localized general property damage
- Power Interruption
- Loss of commerce
- Loss of historical structures

Impacts to Humans
- Loss of life
- Personal injury
- Displaced persons/lack of shelter


Structures at risk in the high hazard area.

Fire Hazard Vulnerability

Extent of Vulnerable Zone

A High Fire Hazard Area has been established for approximately a 60- to 65-acre area of downtown Juneau area as described above and shown on Map 11 on page 60. This zone has the potential for an area-wide conflagration based on the number of older wooden structures, the common occurrence of high southerly winds, and a history of large fires in a similar type of neighborhood in nearby Douglas.

Existing Community Assets

Community assets considered in the vulnerability assessment included an inventory of structures, infrastructure facilities, and the contents of structures. Structure and infrastructure values were provided in GIS format by CBJ for the downtown area by land parcel. Values of structures were treated independently of property value, which were not included in the loss estimates. That is, it was assumed that the loss would be to the structure only, not land value.

Structure values were obtained from the CBJ tax assessor's database for the following numbers of structures in seven different occupancy classifications: 9,257 residential, 539 commercial, 94 government, 54 utilities, 41 religious or non-profit, 244 industrial, and 17 educational. The value of contents within structures was estimated based on guidelines published by FEMA[15], which provide estimates by structure type as a percentage of overall structural value. For the purpose of the vulnerability assessment, it was assumed that a total loss for both structure and contents would occur in the event of a large fire.

The values data were queried in the GIS database for parcels that overlap the High Fire Hazard Area. Loss estimates resulting from this inventory are summarized on Map 11 on page 60. Structural losses within the high hazard zone are estimated to total approximately $332 million, and the estimated value of the contents of those structures is approximately $457 million.

Critical Facilities

Critical facilities were identified within the High Fire Hazard Area as a subset of total community assets. Facilities were designated as critical if they are: (1) vulnerable due to the type of occupant (children, elderly, hospitalized, etc.); (2) critical to the community's ability to function (roads, power generation facilities, water treatment facilities, etc.); (3) have a historic value to the community (cemetery, museum, etc.); or (4) critical to the community in the event of a disaster (police, fire stations, hospitals, emergency operations centers, etc.).

The following types of critical facilities were identified within the hazard zone: Churches, the City Library, Offices, Parks, a Post Office, a Power Generation Facility, and Stores. Land parcels

[15] Federal Emergency Management Agency (FEMA). 2001. State and Local Mitigation Planning, How-to Guide for Understanding Your Risks: Identifying Hazards and Estimating Losses, FEMA 386-2. August.

with critical facilities were queried in the GIS database separately from the total community assets inventory, and the results are listed below in Table 12 and on Map 12 on page 65. The estimated loss of critical facility structures and their contents in the event of a large fire totals approximately $789 million.

Table 13 Critical Facilities in High Fire Hazard Zone

High Hazard Area	Number of Critical Facilities
Church	7
City Library	1
Office	110
Park	3
Post Office	1
Power Generation Facility	1
Store	31

Vulnerable Population

Estimates of population loss in the event of a large fire are based on the following assumptions:

- Average population per parcel was calculated using CBJ population housing type codes (2001 Census data), TAZ codes, and geographic area population estimates. Total population by housing unit was divided by total number of parcels to determine population by parcel.
- Population data was not available for other than residential housing units (unless a commercial or industrial coded parcel had a residential housing unit code applied to it {e.g. COMM/1+AP}).
- Population information is not currently available to assist in identifying the number of persons employed by parcel. For the purposes of this project, it is assumed that approximately 16,700 people are currently employed in the Juneau area (2000 Census data). Based on the locations of offices within each hazard area it is conservatively assumed that 25% (4,175 people) of the employable population could be located within any of the three hazard areas at the time of a hazard event.
- As described in Section 2 of this plan, tourism brings over 800,000 visitors per year to the Juneau area. As it is impossible to predict when a hazard may occur, it is also impossible to predict where visitors may be during an event. For this purposes of this project, it is conservatively assumed that 1% (8,000 people) of the yearly tourist population could be located within any of the three hazard areas at the time of a hazard event, based on a peak daily cruise ship visitation of 7,500 and 500 independent visitors.
- The survival rate for persons located within a hazard zone in the event of a fire was assumed to be zero.

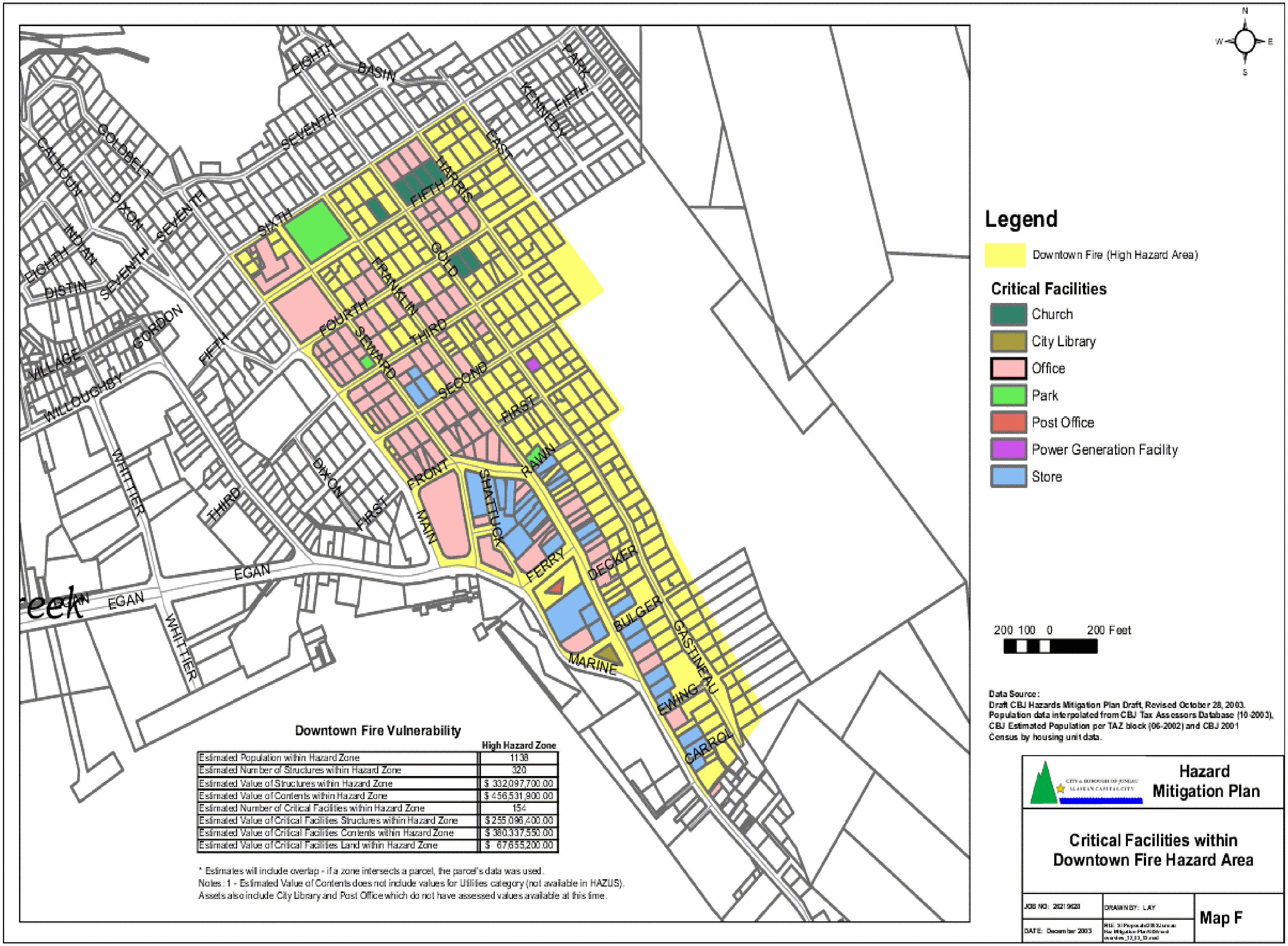
These data were entered into the GIS database and queried where parcels overlapped the high hazard fire zone. The resulting population loss totals approximately 1,137 people.

Future Development

Most of the downtown High Fire Hazard Area is already developed and zoned for high density structures. Thus, future development or redevelopment is unlikely to increase the loss estimates substantially, and may actually lower the risk of fire loss due to the more restrictive fire preventative requirements for development in the area.

Data Limitations

Loss estimations in the vulnerability assessment are limited by assumptions used in defining the High Fire Hazard Area and in establishing parameters for the GIS queries, the results of which are likely to be on the conservative side. The hazard area is based primarily on building type and age, and not by a history of large fires in this particular area (see Local Fire Hazard Identification, above) and the data provided in Maps 10 and 11 should be used for planning purposes only. Value estimates of structures and contents were assumed to be a total loss for every parcel in the hazard area in the event of a fire.



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Map 12 Critical Facilities Within Downtown Fire Hazard Area

Downtown Fire Mitigation

Current CBJ Fire Mitigation Activities

1. Building and fire codes: The 1997 Uniform Building Code (UBC) and Uniform Fire Codes are currently enforced within the CBJ. The CBJ as also adopted several additions, deletions, and changes to the 1997 Uniform Code for the Abatement of Dangerous Buildings. CBJ regulations state that if major construction is proposed on an existing building, or the current use of a building is going to change, then that building must conform to the building and fire codes currently in place. The CBJ General Engineering Division is in charge of monitoring new construction activity. The Building Division of the Community Development Department handles zoning and building code inspections. If new development does not conform to code, fines are given for both the first and second offense; the third offense results in a mandatory court date. A number of the buildings in the downtown area were built before building or fire codes were put in place, and could be out of compliance with current codes. At this time, there is no enforcement mechanism in place to force these buildings to come into compliance with existing building and fire code standards, other than proposed use changes or significant construction.

CBJ Mitigation Ideas

Goal: Reduce the vulnerability of downtown structures to fire in terms of loss of life and property.

- **Mandatory sprinklers for downtown structures.** Fire sprinklers are widely recognized as the single most effective method for fighting the spread of fires in their early stages - before they can cause severe injury to people and damage to property. Requiring downtown buildings to have sprinkler systems protects not only each individual building but neighboring structures as well.
- **Increase code enforcement.** All buildings should be in compliance with current fire codes. Additional resources should be dedicated to inspections to ensure that all downtown buildings are in compliance.
- **Incentives for building owners to incorporate fire protection measures.** Building owners could be offered incentives such as low interest loans, tax reductions, grants, etc. for increasing fire protection of their buildings. Obtaining voluntary compliance is a less controversial way of increasing fire protection because building owners are less likely to feel put upon with too many new codes and requirements.
- **More restrictive fire codes**. Increasing fire protection requirements can help protect buildings from fires.

Goal: reduce risk of fire in downtown Juneau. .

- **Place cigarette receptacles in strategic locations to discourage careless disposal of cigarette butts.**
- **Restrict open burning/campfires in hazard area.** Camp and cooking fires in proximity to structures and vegetation can be a significant fire hazard.
- **Further restrict smoking in the downtown area and in hotels/motels.** Smoking is a major cause of fires. Discarded cigarette butts can ignite trash or vegetation and cause a fire. Buildings that are not equipped with sprinkler systems should not allow smoking.

EARTHQUAKES

Large earthquakes are caused by a sudden release of accumulated stresses between crustal plates that move against each other on the earth's surface. The dangers associated with earthquakes include ground shaking, surface faulting, ground failures, snow avalanches, seiches and tsunamis. The extent of damage is dependent on the magnitude of the quake, the geology of the area, distance from the epicenter and structure design and construction.

Earthquakes are of concern in the Juneau area because of the city's proximity to large fault systems as well as the likelihood of the occurrence of landslides, avalanches, tsunamis and seiches resulting from a significant earthquake.

Hazard Description and Characterization

Ground shaking is caused by seismic waves generated by an earthquake. P (pressure or primary) waves are the first ones felt, often as a sharp jolt. S (shear or secondary) waves are slower and usually have a side to side movement. S waves can be very damaging because structures are more vulnerable to horizontal than vertical motion. The damage to buildings depends on how the specific characteristics of each incoming wave interact with the buildings' height, shape, and construction materials.

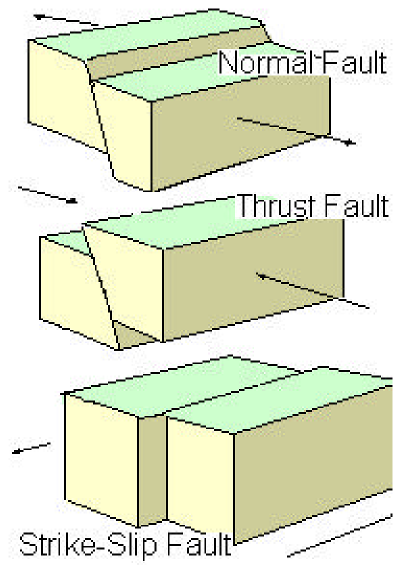
Earthquakes are usually measured in terms of their magnitude and intensity. Magnitude is related to the amount of energy released during an event while intensity refers to the effects on people and structures at a particular place. Earthquake magnitude is usually reported according to the standard Richter scale for small to moderate earthquakes. Large earthquakes, like those that commonly occur in Alaska, are reported according to the moment-magnitude scale because the standard Richter scale does not adequately represent the energy released by these large events.

Richter Scale

On the Richter scale, magnitude is expressed in whole numbers and decimals. A 5.0 earthquake is a moderate event, 6.0 characterizes a strong event, 7.0 is a major earthquake and a great earthquake exceeds 8.0. The scale is logarithmic and open-ended.

Intensity is usually reported using the Modified Mercalli Intensity Scale. This scale has 12 categories ranging from "not felt" to "total destruction." Different values can be recorded at different locations for the same event depending on local circumstances such as distance from the epicenter or building construction practices. Soil conditions are a major factor in determining an earthquake's intensity, as unconsolidated fill areas will have more damage than will an area with shallow bedrock.

Surface faulting is the differential movement of the two sides of a fault. There are three general types of faulting. Strike-slip faults are where each side of the fault moves horizontally. Normal faults have one side dropping down relative to the other side. Thrust (reverse) faults have one side moving up and over the fault relative to the other side.



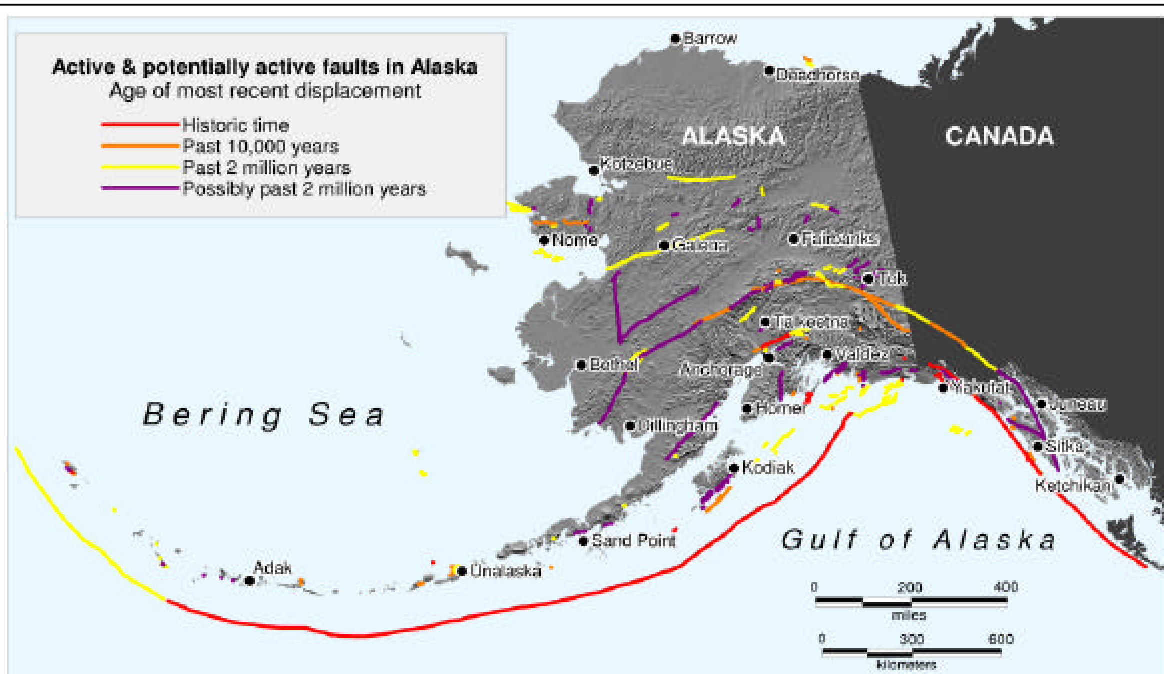
Three types of faults. Image courtesy of USGS.

Earthquake-induced ground failure is often the result of liquefaction, which occurs when soil (usually sand and course silt with high water content) loses strength as a result of the shaking and acts like a viscous fluid. Liquefaction can cause building and bridge collapse as well as landslides and avalanches.

Alaska's Seismic Activity

Approximately 11% of the world's earthquakes occur in Alaska, making it one of the most seismically active regions in the world. Three of the ten largest quakes in the world since 1900 have occurred here. Earthquakes of magnitude 7 or greater occur in Alaska on average of about once a year; magnitude 8 earthquakes average about 14 years between events.

Approximately 75% of Alaska's detected earthquakes occur in the Alaska Peninsula, Aleutian Islands, and the Anchorage area. About 15% occur in Southeast Alaska and the remaining 10% occur in the Interior. The largest earthquake in recent North American history occurred in the Alaska-Aleutian seismic zone. That M9.2 quake lasted between four and five minutes and was felt over a 7,000,000 square mile area. It caused a significant amount of ground deformation as well as triggering landslides and tsunamis resulting in major damage throughout the region. The megathrust zone where the North Pacific Plate plunges beneath the North American Plate still



has the potential to generate earthquakes up to magnitude 9.

Southeast Alaska experiences earthquakes from the Queen Charlotte-Fairweather fault. Recent large events include a magnitude 8.1 earthquake in 1949 and the magnitude 7.9 event in 1958 that triggered the giant landslide-generated wave in Lituya Bay.

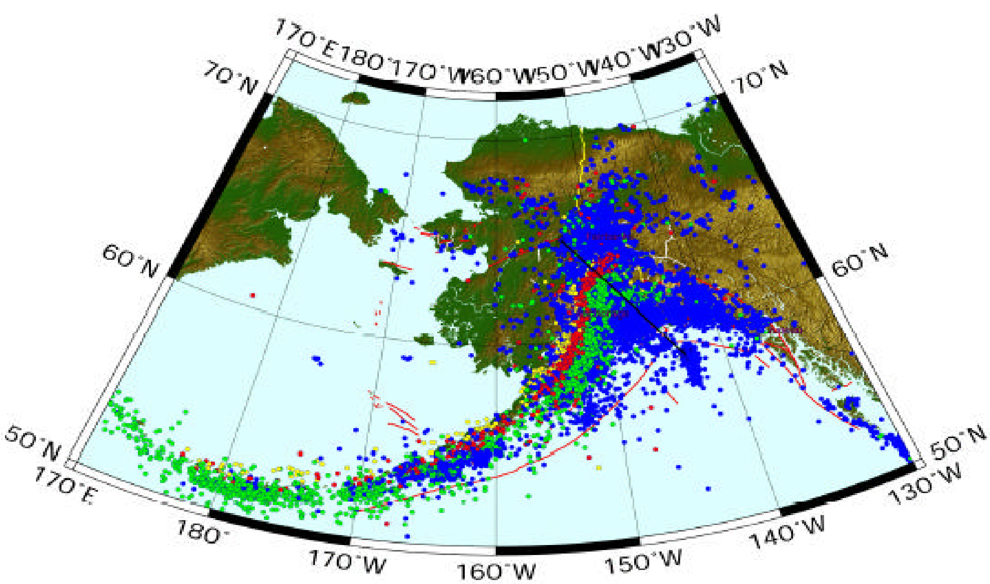
A lack of large earthquakes along a portion of an active plate margin can be cause for concern. This may indicate the development of a seismic gap, which is an area where there has not been a major earthquake for a much longer time than in adjacent areas. There may be higher likelihood of a strong earthquake in these areas in the future because of strain buildup.

Local Earthquake Hazard Identification

Earthquakes in Southeast Alaska

Much of the following information is from the State of Alaska Department of Natural Resources publication "Planning Scenario: Earthquakes for Southeast Alaska" by Roger A. Hansen and Rodney A. Combellick; 1998. Available at http://dggs.dnr.state.ak.us/scan1/mp/text/mp34.pdf.

Approximately 15% of Alaska's earthquakes occur in Southeast Alaska. Of particular interest are the large events that have occurred on the strike-slip faults associated with the Queen Charlotte-Fairweather fault system. This plate boundary between the North American plate and the Pacific plate is very analogous to the well known San Andreas fault system in California, and is essentially a northward extension of the right-lateral motion as the two plates slide past each other. The Fairweather fault is clearly active, having caused three recent moderate to large earthquakes (M8.1 in 1949, M7.9 in 1958 and M7.6 in 1972).



Earthquakes in Alaska 1988-1999.

At the northern end of this fault system, near Yakutat Bay, spectacular surficial effects were produced by a magnitude 8.2 earthquake in 1899. Here a vertical fault displacement of 15 meters was observed as the plates collide. In addition a destructive tsunami over 10 meters high was generated in Yakutat Bay. To the south four earthquakes occurred this century with magnitudes greater than 7.0, all of which involved dextral slip: in 1927 an event of magnitude 7.1 located near latitude 57.7 degrees north; in 1949 a magnitude 8.1 event on the Queen Charlotte fault originating near 53.6 degrees north and rupturing nearly 500 km to the north and south; in 1958, a magnitude 7.9 earthquake ruptured about 350 km of the Fairweather fault with measured onshore displacement up to 6.6 meters (shaking from this event induced a large landslide at the head of Lituya Bay causing a spectacular water wave that surged up and deforested the opposite shore of the fjord to an elevation of 530 meters); and the magnitude 7.4 Sitka earthquake in 1972, which ruptured a 190-km segment of the fault system between the northern limit of the 1949 event and the southern limit of the 1958 event.

The Sitka event had been identified as a seismic gap and a likely site for an earthquake, and thus was a successful forecast. Although all the well recorded historic shocks larger than magnitude 7.0 have occurred on the main plate boundary, significant seismicity occurs eastward of the Queen Charlotte-Fairweather fault system. For example, seismicity follows the southern end of the Denali fault system and has produced historic earthquakes up to at least magnitude 6.5. The Denali fault appears to join to the Chatham Strait fault system and continue past the Juneau area. While little historic seismicity is associated directly with the Chatham Strait fault, there is sufficient geologic evidence of activity to consider this fault as a capable fault for a planning scenario earthquake due to its proximity to the population center in Juneau.

Earthquakes in Juneau

Historical information about Juneau earthquakes is difficult to find. Because of its proximity to fault lines, it is certain that earthquakes have occurred in the Juneau area in the past, but it is unlikely that a written record exists of any significant quakes that have affected the Juneau area. Large earthquakes are rare events in general, and the lack of historical information regarding large earthquakes in the last 200 years should not be used as an indicator for the likelihood of future events. Minor earthquakes have been detected in Southeast Alaska as recently as June 9, 2004[16], indicating that area fault lines are still active and should be considered a threat.

Tsunami Potential

Tsunamis (seismic sea waves) are generated by sudden vertical motion of the sea floor. Because the Fairweather and Denali/Chatham Strait fault systems are strike-slip (sideways motion parallel to the fault), they are not likely to generate tsunamis. However, earthquake ground shaking can indirectly cause locally generated waves by triggering landslides in the steep terrain nearby. If a major landslide enters sea water or occurs on the seafloor, a large local wave can be generated that can be devastating to people and facilities along nearby shorelines. There is little warning because the waves can travel from the source to nearby coastal areas in a matter of minutes.

[16] http://earthquake.usgs.gov/recenteqsUS/Quakes/ak00037280.htm

Liquefaction Potential

The possibility of soil liquefaction is a significant concern for parts of the Juneau area. The Mendenhall Valley floor, as well as other areas of the city, may present a high risk of liquefaction in the event of an earthquake.

Earthquake Hazards Summary

Potential Damage

- Building collapse
- Property loss
- Loss of commerce
- Bridge Damage or Collapse
- Power interruption
- Communications interruption
- Transportation Interruption

Impacts to Humans

- Crushing/impact injuries
- Displaced persons/lack of shelter

Other Hazards

- Fire
- Landslide
- Avalanche
- Tsunami
- Dam Failure

Earthquake damage to buildings in Anchorage, Alaska after the 1964 earthquake.

Earthquake Hazard Vulnerability

To be added

Earthquake Mitigation

CBJ Earthquake Mitigation Ideas

Goal: Reduce vulnerability of structures to earthquake damage.

- **Housing inventory**. Determine which buildings are in need of seismic retrofitting. A housing inventory can also be useful when responding to disasters; if houses and buildings have been destroyed it is useful to know which buildings are likely to have been damaged

- **Check major existing buildings and bridges for earthquake resistance.** Inspect buildings for earthquake resistant construction and make sure all buildings are properly up to code.
- **Strengthen weak buildings**. Utilize seismic retrofitting techniques to make at-risk buildings safer.
- **Map soils with risk of settling or liquefaction**. Knowledge of high risk areas makes ordinance changes and building codes more effective.
- **Establish special building/zoning codes in areas found to be at high risk.** New construction should be limited to areas that are not vulnerable to settling and liquefaction, and should meet all requirements for seismic protection.
- **Retrofitting of bridges.** Ensure that bridges are brought to their maximum capability by retrofitting them against seismic damage.

Goal: Promote public education regarding earthquake hazards.

- **Public education**. Earthquakes are typically disregarded as a significant threat to Juneau. The public should be aware of the seismic hazard and its possible effects on the community.

SEVERE WEATHER

Weather is the result of interactions between the sun, the atmosphere, moisture, and the structure of the planet. Certain combinations can result in severe weather events that have the potential to become disasters.

The Juneau Forecast Office of the National Weather Service lists thunderstorms, waterspouts, hail, high winds, dense fog, freezing rain, blizzards, arctic cold outbreaks with dangerous wind chill temperatures, and heavy snow as possible severe weather events in the Juneau area. Mariners in the region can expect storm force winds and heavy freezing spray events.[17] Extreme weather events in Juneau may be accompanied by secondary effects such as flooding, landslides, and avalanches. Severe weather should be expected throughout the Juneau Borough.

Hazard Description and Characterization

Severe Weather Events

Winter Storms

Winter storms originate as mid-latitude depressions or cyclonic weather systems. High winds, heavy snow, and cold temperatures usually accompany them. To develop, they require:

- Cold air - Subfreezing temperatures (below 32ºF, 0ºC) in the clouds and/or near the ground to make snow and/or ice.
- Moisture - The air must contain moisture in order to form clouds and precipitation.
- Lift - A mechanism to raise the moist air to form the clouds and cause precipitation. Lift may be provided by any or all of the following:
  - The flow of air up a mountainside;
  - Fronts, where warm air collides with cold air and rises over the dome of cold air; and
  - Upper-level low pressure troughs.

Heavy Snow

Heavy snow (6 inches or more in 12 hours or a foot or more in 24 hours) can immobilize a community by bringing transportation to a halt. Until the snow can be removed, airports and major roadways are impeded and may even close completely, stopping the flow of supplies and disrupting emergency and medical services. Accumulations of snow can cause roofs to collapse and knock down trees and power lines. Heavy snow can also damage light aircraft and sink small boats. On mountainsides and slopes, heavy snow can lead to avalanches. A quick thaw after a heavy snow can cause substantial flooding, especially along small streams and in urban

[17] http://pajk.arh.noaa.gov/spotter.php

areas. The cost of snow removal, repairing damages, and the loss of business can have severe economic impacts on cities and towns.

Injuries and deaths related to heavy snow usually occur as a result of vehicle accidents. Casualties also occur due to overexertion while shoveling snow and hypothermia caused by overexposure to the cold weather.

Extreme cold

What is considered an excessively cold temperature varies according to the normal climate of a region. In areas unaccustomed to winter weather, near freezing temperatures are considered "extreme cold." Excessive cold may accompany winter storms, be left in their wake, or can occur without storm activity. Wind chill temperatures to -50 °F are possible in the Juneau area and the all time record low temperature at the airport is -22 °F.

Extreme cold interferes with a community's infrastructure. It causes fuel to congeal in storage tanks and supply lines, stopping electric generation. Without electricity, heaters do not work, causing water and sewer pipes to freeze or rupture. If extreme cold conditions are combined with low or no snow cover, the ground's frost depth can increase disturbing buried pipes.

Snow Terminology

Snow is defined as a steady fall of snow for several hours or more.

Heavy Snow generally means:

- Snowfall accumulating to 6 inches or more in depth in 12 hours or less
- Snowfall accumulating to 12 inches or more in depth in 24 hours or less

Snow Squalls are periods of moderate to heavy snowfall, intense, but of limited duration, accompanied by strong, gusty surface winds and possibly lightning.

A Snow Shower is a short duration of moderate snowfall.

Snow Flurries are an intermittent light snowfall of short duration with no measurable accumulation.

Blowing Snow is wind-driven snow that reduces surface visibility. Blowing snow can be falling snow or snow that already has accumulated but is picked up and blown by strong winds.

Drifting Snow is an uneven distribution of snowfall and snow depth caused by strong surface winds. Drifting snow may occur during or after a snowfall.

Freezing Rain or Drizzle occurs when rain or drizzle freezes on surfaces such as the ground, trees, power lines, motor vehicles, streets, highways, etc.

A Blizzard means that the following conditions are expected to prevail for a period of 3 hours or longer:

- Sustained wind or frequent gusts to 35 miles per hour or greater
- Considerable falling and/or blowing snow reducing visibility to less than 1/4 mile

The greatest danger from extreme cold is to people. Prolonged exposure to the cold can cause frostbite or hypothermia and become life-threatening. Infants and elderly people are most susceptible. The risk of hypothermia due to exposure greatly increases during episodes of extreme cold, and carbon monoxide poisoning is possible as people use supplemental heating devices.

Ice Storms

The term *ice storm* is used to describe occasions when damaging accumulations of ice (1/4 inch or more) are expected during freezing rain situations. They can be the most devastating of winter weather phenomena and often cause automobile accidents, power outages and personal injury. Ice storms result from the accumulation of freezing rain, which is rain that becomes supercooled and freezes upon impact with cold surfaces. Freezing rain most commonly occurs in a narrow band within a winter storm that is also producing heavy amounts of snow and sleet in other locations.

Freezing rain develops as falling snow encounters a layer of warm air in the atmosphere deep enough for the snow to completely melt and become rain. As the rain continues to fall, it passes through a thin layer of cold air just above the earth's surface and cools to a temperature below freezing. The drops themselves do not freeze, but rather they become supercooled. When these supercooled drops strike the frozen ground, power lines, tree branches, etc., they instantly freeze.

Taku winds in downtown Juneau and Douglas

High Winds

High winds are the most common severe weather in Southeast Alaska. In the downtown Juneau and Douglas areas the mountainous terrain induces what are known locally as *Taku winds*. These high winds form an average of four times per year from October through April. Under certain conditions, strong offshore northeasterly winds are funneled down Taku Inlet and up over the northwest-southeast oriented mountains south of downtown Juneau. These mountains impart a wave on the strong northeast ridgetop flow and on surface high winds at sea level. Hurricane force wind gusts (72 mph or greater) occur roughly once every two years during these Taku wind events. Taku winds produce strong wind shear and turbulence that can impact flights into and out of the Juneau airport. Another result of these strong offshore northeast winds is storm force winds and heavy freezing spray at the mouth of Taku Inlet. Mariners in the region can be held up for several days until the dangerous marine weather conditions subside.

High winds can also result in Juneau from strong low pressure systems moving in from the Gulf of Alaska. These wind events are more rare (on average once every ten years), but the damage to property and trees is much more widespread. Generally a low must be 970mb or lower to generate high winds as it tracks through the Northern Panhandle. This threat exists primarily during the fall and winter months.

Localized downdrafts, downbursts and microbursts are also a significant hazard. Downbursts and microbursts can be generated by thunderstorms. Downburst winds are strong concentrated straight-line winds created by falling rain and sinking air that can reach speeds of 125 mph. The combination induces a strong wind downdrafts due to aerodynamic drag forces or evaporation processes. Microburst winds are more concentrated than downbursts and can reach speeds up to 150 mph. They can cause significant damage as both can last 5-7 minutes. Because of wind shear and detection difficulties, they pose a big threat to aircraft landings and departures.

Thunderstorms & Lightning
Thunderstorms are caused by the turbulence and atmospheric imbalance that arise from combining unstable rising warm air and adequate moisture to form clouds and rain. A thunderstorm can intensify into a severe storm with damaging hail, high winds, and flash flooding. A thunderstorm is considered severe if winds reach or exceed 58 mph, produces a tornado, or drops surface hail at least 0.75 inches in diameter.

Thunderstorms affect relatively small areas. The average thunderstorm is about 15 miles in diameter and lasts less than 30 minutes in any given location.

Lightning exists in all thunderstorms. It is caused by a buildup of charged ions within the thundercloud. When lightning connects with a grounded object, electricity is released which can be harmful to humans and can start fires. Lightning is the single biggest hazard from thunderstorms in Southeast Alaska.

The thunderstorms that occur in Alaska are usually the single-cell or "pulse" variety. They usually develop due to a combination of atmospheric instability and moisture triggered by surface heating from the sun. These storms generally last only 20-30 minutes and do not usually produce severe weather. But rarely, a pulse thunderstorm may produce brief high winds, hail, or weak tornadoes. Multi cell thunderstorm and squall line tornadoes are rare in Alaska and super cell thunderstorms are unprecedented. The Juneau area averages a thunderstorm every two years. Thunderstorms can occur any time of year, but are most likely from May until September. Though these storms often catch people by surprise and pose a lightning threat, winds are often less than 50 mph. These wind gusts can still pose a hazard to aircraft but thunderstorms in Southeast Alaska simply are not tall enough to generate high winds.

A much more common impact of thunderstorm activity in Alaska is wildfire. There is no lightning detection sensor network in Southeast Alaska. As wildfire danger rises, lightning strikes will become a more significant concern in Southeast Alaska.

Waterspouts
Waterspouts are possible in Southeast Alaska. Waterspouts are weak tornadoes that form over water. Winds to 70 mph are possible in these waterspouts and mariners should avoid them at all costs.


Waterspouts are possible in Southeast Alaska.

Hail
Hailstorms are an outgrowth of thunderstorms in which ball or irregular shaped lumps of ice greater than 0.75 inches in diameter fall with rain. The size and severity of the storm determine the size of the hailstones. In Alaska, hailstorms are fairly rare and cause little damage, unlike the hailstorms in Mid-western states. The extreme conditions of atmospheric instability needed to generate hail of a damaging size (greater than ¾ inch diameter) are highly unusual in Alaska. Small hail of pea-

size has been observed periodically. Hailstones up to an inch in diameter are possible with thunderstorms in Southeast Alaska. Minor damage can occur from hailstones that size.

Dense Fog

Dense fog is defined as fog reducing visibilities to ¼ mile or less for an hour or longer. Fog usually forms under clearing skies after several days of rain. An inversion (stable atmosphere) forms in the valleys and channels that can last for several days. This inversion shelters the fog from mixing out from winds. The fog will last until the inversion mixes out due to winds picking up from a weather front moving into the area.

Dense fog episodes occur often in Southeast Alaska and can last as long as a week at a time. The most prolific time of year for dense fog to occur in the Juneau area is during the months of November and December. Dense fog is significant not only because it can pose a hazard to mariners and roadways, but it can also significantly affect aviation travel. The Juneau airport is adjacent to mud flats on the Gastineau Channel, a favored area for fog formation.

Coastal Storms/Storm Surges

From the fall through the spring, low pressure cyclones either develop in the Bering Sea or Gulf of Alaska or are brought to the region by wind systems in the upper atmosphere that tend to steer storms in the north Pacific Ocean toward Alaska. When these storms impact the shoreline, they can bring wide swathes of high winds and occasionally cause coastal flooding and erosion. The key for generating coastal flooding in Southeast Alaska is that the storm surge must coincide with high tide. The low pressure center must be 980mb or lower to generate such a swell. These swells will usually approach the coast from the west or southwest. Sea heights often are greater than 20 feet. If they coincide with a high tide (usually it must be a strong high tide of 20 feet or greater), the surf and wave action can be such that damage will occur in harbors and marinas. Flooding and erosion will also occur on the land adjacent to the water.


Storm surge at Sandy Beach

The meteorological parameters conducive to coastal flooding are low atmospheric pressure, strong winds (blowing directly onshore or along the shore with the shoreline to the right of the direction of the flow), and winds maintained from roughly the same direction over a long distance across the open ocean.

Local Severe Weather Hazard Identification

The National Weather Service Forecast Office in Juneau monitors for severe weather in Southeast Alaska. They coordinate weather forecasts and warnings with local emergency managers, the media, and other government agencies. All weather watches and warnings are issued when conditions warrant. The National Weather Service works with local emergency managers to ensure that the appropriate actions are taken once a weather watch or warning is disseminated.

Juneau Extreme Weather

Extreme weather is common in Juneau. Taku winds, excessive rain, flooding, dense fog and heavy snow occur every year in the Juneau area. Thunderstorms, lightning, hail, and coastal flooding type storms are less common but possible.

Table 14 Juneau Weather Extremes

Juneau Weather Extremes (based of historical weather record since 1943 at the Juneau Airport)	
Record Maximum Temperature:	90 °F on July 7, 1975
Record Minimum Temperature:	-22 °F on January 12, 1972 and February 2, 1968
Record consecutive days with *high* temperatures at or below 32 °F	53 straight days from December 21, 1949 through February 11, 1950
Record consecutive days with *high* temperatures at or below 0 °F	6 straight days from January 28 through February 2, 1947
Record consecutive days with *low* temperatures at or below 32 °F	114 straight days from November 29, 1968 through March 22, 1969
Record consecutive days with *low* temperatures at or below 0 °F	19 straight days January 6-24, 1969
Record consecutive days with *high* temperatures at or above 70 °F	13 straight days from August 2-14, 1994 and from May 28-June 9, 1958
Latest hard freeze (start to growing season)	May 19, 1965
Earliest hard freeze (end to growing season)	August 25, 1948
Record growing season (low temperatures were above freezing, 32 °F)	198 days from April 19 through November 2, 1993
Average annual precipitation	56.54 inches
Driest year on record	37.80 inches of precipitation in 1951
Wettest year on record	85.15 inches of precipitation in 1991
Average driest month	April with 2.81 inches of precipitation
Record driest month	0.07 inches of precipitation in February 1989
Average wettest month	October with 7.91 inches of precipitation

Juneau Weather Extremes (based of historical weather record since 1943 at the Juneau Airport)	
Record wettest month	15.25 inches in October of 1974
Record 1 day rainfall	4.62 inches on October 10, 1946
Record rainfall for 2 consecutive days	6.46 inches on October 19-20, 1998
Record consecutive days with precipitation of an inch or more	3 straight days (has occurred six times in the past)
Record consecutive days with precipitation of a half inch or more	5 straight days from December 21-25, 1997 and September 6-10, 1981
Record consecutive days with precipitation a tenth of an inch or more	18 straight days from November 29 through December 16, 1991
Record consecutive days with measurable precipitation (0.01” or more)	49 straight days from September 29 through December 11, 1999
Record consecutive days with no measurable precipitation (Trace or 0)	22 straight days from April 10-May 1, 1979 and January 6-27, 1957
Average annual snowfall	96.2 inches
Least snowfall during a winter	24.4 inches of snow during the 1987-88 winter
Most snowfall during a winter	194.3 inches of snow during the 1964-65 winter
Average snowiest month	January with 25.1 inches of snow
Record snowfall for a month	86.3 inches of snow in February 1965
Record 1 day snowfall	30.6 inches on March 21, 1948
Record 2 day snowfall	38.6 inches on April 2-3, 1963
Record consecutive days with snowfall of foot or more	2 straight days from January 15-16, 1966 and April 2-3, 1963
Record consecutive days with snowfall of a 6 inches or more	3 straight days (has occurred six times in the past)
Record consecutive days with snowfall of an inch or more	10 straight days from December 2-11, 1975
Record consecutive days with measurable snowfall (0.10” or more)	15 straight days from February 12-26, 1965
Record consecutive days with no measurable snowfall (Trace or 0)	275 straight days from March 14 through December 13, 2002
Earliest measurable snowfall in autumn	October 2, 2000 (2” of snow occurred)
Latest measurable snowfall in spring	April 27, 1972 (2” of snow occurred)
Highest recorded peak wind gust (measured at Federal Building)	92 mph on November 22, 1984

Severe Weather Hazards Summary

Potential Damage

- Damage to structures (high winds, snow loading)
- Interruption of services (power outages)
- Transportation interruption(fog, road closures, interruption of ferry and airport services)

Impacts to Humans

- Personal injury (vehicle collisions, hypothermia/freezing, trauma)
- Displaced persons/lack of shelter
- Property loss

Storm surge at Sandy Beach

Severe Weather Hazard Vulnerability

To be added

Severe Weather Mitigation

CBJ Severe Weather Mitigation Activities

1. Flood elevation levels for coastal construction. New construction of any residential structure must be above base flood elevation.

2. FAA and National Centers for Atmospheric Research (NCAR) Wind Shear Study for the Juneau Airport. The FAA has partnered with NCAR and the National Weather Service in Juneau over the past several years on conducting an intensive turbulence and wind shear study on the flight paths into and out of the Juneau Airport. The goal of the elaborate study is to develop an automated alert system that will advise the Tower and pilots (both commercial and private) during periods of extreme turbulence and wind shear in the Juneau area. Funding for this project is on a year by year basis and it remains to be seen if this study will be completed.

CBJ Severe Weather Mitigation Ideas

Goal: Increase warning time and public awareness of imminent severe weather events.

- ***Develop accurate regional wind risk maps.***
- ***Installation of more automated weather sensors.*** Automated weather sensors are the chief method by which the National Weather Service detects the occurrence of high

winds in the Juneau Borough. The National Weather Service hopes to add additional wind sensors in various strategic locations in the coming years that will improve detection of high winds. Installation of such sensors is based on available funding from year to year.

- ***Improving Doppler radar coverage.*** The best way to monitor for severe weather is through Doppler Weather Radar. Throughout the country, the National Weather Service successfully monitors for severe weather events (high winds, thunderstorms, heavy snowfall, etc.) by tracking storms and precipitation intensity using Doppler radar. The local National Weather Service Forecast Office is trained to incorporate the monitoring and utilization of Doppler radar data into their warnings and forecasts.

  Currently there is only one Doppler radar in Southeast Alaska (Biorka Island southwest of Sitka) and it does not provide any radar coverage for the CBJ. The Juneau Borough is the most densely populated location in the entire country without Doppler radar coverage. The lack of that data severely handicaps the ability of the local National Weather Service office to monitor and effectively warn for impending severe weather.

Goal: Reduce vulnerability to severe weather events.

- ***Modify building codes through ordinance changes to reflect regional risks as defined on wind maps.***
- ***Qualify Juneau as StormReady*.** StormReady is a nationwide community preparedness program that uses a grassroots approach to help communities develop plans to handle all types of severe weather—from tornadoes to tsunamis. The program encourages communities to take a new, proactive approach to improving local hazardous weather operations by providing emergency managers with clear-cut guidelines on how to improve their hazardous weather operations.

FLOODS

Flooding is a natural event. Damages occur when human development encroaches on floodplains via altering the waterway, developing watersheds, and/or building inappropriately within the floodplain. Flooding threatens life, safety and health and causes extensive property loss. Flood damages are easily prevented when human settlements are kept out of floodplains.

Encroachment on floodplains, such as artificial fill, reduces the flood-carrying capacity, increases flood heights of streams, and increases flood hazards in areas beyond the encroachment itself. Floods in the Juneau area can occur as a result of a combination of factors including heavy snowpack, rapid temperature fluctuations, and heavy precipitation. Since most development is along the coastlines, the most serious stream flooding will result when peak stream flows occur simultaneously with high tides. This causes the stream to back up and flood at higher elevations. High winds combined with high tides, however, will create storm surge and wave runup, representing the greatest flooding threat to the coastal areas.

Hazard Description and Characterization

Types of Flooding

Rainfall-Runoff Floods

Rainfall events can occur year round in the Southeast Alaska rainforest. Juneau itself averages 58.33” of precipitation annually. August through November is wettest time of year as nearly half (26.64”) of the annual precipitation occurs during those four months. During this time of year, rainfall-runoff flooding is prevalent in the Juneau region. The rainfall intensity, duration, distribution and geomorphic characteristics of the watershed all play a role in determining the magnitude of the flood.

Runoff flooding is the most common type of flood in Southeast Alaska. They usually result from weather systems that have prolonged rainfall associated with them. Debris slides and mudslides are possible. High elevation snows in late autumn can rapidly melt in the warm, southerly winds out ahead of the next upstream storm. This early season runoff combines with the heavy rains, and causes streams and rivers to swell.

Snowmelt Floods

Snowmelt floods usually occur in the spring or early summer. The depth of the snowpack and spring weather patterns influence the magnitude of flooding. Snowmelt floods can also be caused by glacial melt. In Southeast Alaska, stream and river levels are usually very low during the spring thaw. It would take the combination of an above normal winter snowpack, unseasonably warm spring temperatures and an unseasonably wet storm system to generate snow melt flooding conditions in the Juneau area during spring. March through June is the driest time of year in Juneau; only 22% (13.31”) of Juneau’s annual precipitation occurs during these four months.

Ground-water Floods

Ground-water flooding occurs when water accumulates and saturates the soil. The water table subsequently rises and floods low-lying areas, including homes, septic tanks, and other facilities.

Ice Jam Floods

Ice jams can form during fall freeze up, in midwinter when stream channels freeze forming anchor ice, and during spring breakup when the existing ice cover gets broken into pieces and the pieces get stuck at bridges or other constrictions. When the ice jam fails, it releases the collected water. Damages from ice jam floods result from the water that builds up behind the jam, and by swiftly flowing water released when the jam fails. Ice jam flood waters can also bear with them large chunks of ice which are very destructive when carried by swift currents.

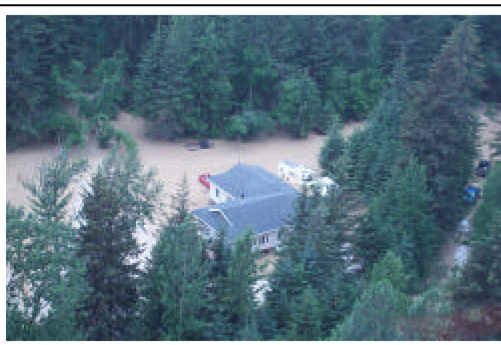
Ice jam floods are rare in Southeast Alaska due to relatively mild winter temperatures and the short distance streams and rivers flow before draining into the ocean.

Flash Floods/Dam Failures

These floods are characterized by a rapid rise in water. They are often caused by heavy rain on small stream basins, ice jam formation or by dam failure. They are usually swift moving and debris-filled, causing them to be very powerful and destructive. Steep coastal areas in general are subject to flash floods. Debris slides and mudslides are often associated with heavy rains.

A large landslide or major glacial calving event into a large lake can also cause a flash flood to be generated downstream. Though this type of flash flood is rare, the impacts can be devastating. In August of 2002 the community of Dyea was impacted by this type of flash flood. A major landslide spilled into a glacial lake upstream of Dyea. A tsunami-like flash flood was generated and raised the height of the West Creek over 15 feet in a half hour. A similar scenario could happen on Mendenhall Lake with the resultant flash flood impacting downstream locations on the Mendenhall River.

Another flash flood threat in the Juneau area is due to a potential failure of the Salmon Creek Dam. A dam failure could generate a large and destructive flash flood. Potential for a similar scenario exists at the Douglas Island Reservoir at Bear Creek.



Flooding in Dyea, 2002

Fluctuating Lake Level Floods

Generally, lakes buffer downstream flooding due to the storage capacity of the lake. But when lake inflow is excessive, flooding of the area around the lake can occur.

Alluvial Fan Floods

Alluvial fans are areas of eroded rock and soil deposited by rivers. When various forms of debris fills the existing river channels on the alluvial fan, the water overflows and is forced to cut a new channel. Fast, debris filled water causes erosion and flooding problems over large areas.

Glacial Outburst Floods

A glacial outburst flood, also known as a jökulhlaup, is a sudden release of water from a glacier or a glacier-dammed lake. They can fail by overtopping, earthquake activity, melting from volcanic activity, or draining through conduits in the glacier dam.

Subglacial releases occur when enough hydrostatic pressure occurs from accumulated water to "float" the glacial ice. Water then drains rapidly from the bottom of the lake. There are no known glacial outburst flood problems that immediately threaten the inhabited areas of the Juneau Borough. Two glacial lakes, Lakes Linda and Lynn, were discovered recently on the Lemon Creek Glacier. These lakes do generate glacial outburst floods but the magnitude is such that flooding does not occur downstream on Lemon Creek. These lakes will need to be monitored in the coming decades in case they grow large enough to generate a significant jökulhlaup on Lemon Creek.

Flood Hazards

Deposition

Deposition is the accumulation of soil, silt, and other particles on a river bottom or delta. For example, 4 foot diameter boulders were found after a Gold Creek flood event in Juneau. Deposition leads to the destruction of fish habitat and presents a challenge for navigational purposes. Deposition also reduces channel capacity, resulting in increased flooding or bank erosion.

Bank erosion

Stream bank erosion involves the removal of material from the stream bank. When bank erosion is excessive, it becomes a concern because it results in loss of streamside vegetation, loss of fish habitat, and loss of land and property.

Contaminated water

Flood waters pose a health hazard by picking up contaminants and disease as they travel. Outhouses, sewers, septic tanks, and livestock yards are all potential sources of disease transported by flood waters. Homes and possessions must be cleaned and sanitized after a flood, and many times must simply be discarded when the damage is too extensive. Public water supplies can be contaminated by flood waters and must be tested to ensure their safety and potability. Private well systems must also be tested and disinfected after a flood.

Lack of a water source is a significant concern for flood victims, especially if the flood has been extensive enough to contaminate the public water supply. In such a case, outside bottled water is at times the only source of clean water.

Personal injury

Swiftly flowing water presents a drowning hazard, regardless of the depth of the water. Even relatively shallow floodwaters of 6" may have a powerful current capable of pulling a human off his or her feet. Flood waters can also rise without warning, transforming a small brook into a raging torrent. Flood waters can also carry large objects with them, making it even more dangerous to be in the path of the flood.

Unpredictable and dangerous flood waters can pose a threat to motorists if they cover roadways. Water that appears shallow may in fact be very deep with a strong current, and caution must be taken when approaching any flooded roadway. Cars and other vehicles can be swept away by floods, making it very dangerous to attempt to drive over a flooded roadway. Culverts meant to allow water to flow under the road can quickly become overwhelmed by excessive water, causing the water to divert and flow over the road or even wash out the road bed.

Property Damage
Water inundation causes tremendous damage to homes and structures. Building materials become saturated with water and can swell, making doors and windows inoperable. Water-saturated building materials become much heavier than they would normally be, which can cause structural damage such as buckling and settling. Materials such as sheet rock can suck up water and lift it with a capillary-type action far above the original level of the flood water. Such materials can be damaged far beyond the water level.

Mildew can quickly set in after a flood, destroying furnishings and causing a health hazard for those with allergies or respiratory conditions. Flood waters usually bring along large quantities of dirt and silt, which are left as deposits when the flood waters recede. Homes and possessions, if not excessively damaged by water, can be devastated by silt deposits.

Local Flood Hazard Identification

Flood Monitoring in Juneau

The National Weather Service Forecast Office in Juneau monitors for flooding in Southeast Alaska. They coordinate hydrological forecasts and warnings with their River Forecast Center in Anchorage. All flood watches and warnings are issued when conditions warrant. The National Weather Service works with local emergency managers to ensure that the appropriate actions are taken once a flood watch or warning is disseminated.

Juneau's primary urban areas at risk of flooding

Floods can occur in Juneau at any time because of its high probability of heavy rainfall. Floods are most likely in August, September, October, and November, during which approximately half of Juneau's average rainfall occurs.

Montana Creek, in the back of the Mendenhall Valley, experiences some form of flooding roughly every three years. This flooding is usually associated with heavy rain events in late summer or fall. Official flood stage (17 feet) on Montana Creek is usually reached by a combination of heavy rains and a spell of warm temperatures that melt early season mountain snow pack. The low lying, back portion of Montana Creek Road experiences minor flooding when the creek rises to its bank-full stage of 15 feet (based on the USGS river gage at the bridge on Back Loop Road.) When the creek reaches 16 feet, water builds to almost an inch deep on the back portion of Montana Creek Road and nearby residents experience flooding in their yards and driveways. At 16 feet, the Mendenhall Campground and Skater's Cabin areas begin to see minor flooding, as well as the undeveloped field adjacent to Montana Creek along the Back Loop Road. At 17 feet, flood waters on Montana Creek cross the Back Loop Road. Several nearby residences would have water flowing into their land and possibly into their first floor. The residents along the back portion of Montana Creek Road would experience flood damages to their homes and property at a 17' flood stage. The Mendenhall Campground and Skater's Cabin areas would experience moderate flooding at this point. The record high water mark on the Montana Creek gage near the Back Loop Road Bridge was 17.30', which occurred on October 20, 1998.

The large **Mendenhall River** runs its seven mile course from Mendenhall Lake, through the Mendenhall Valley, and drains into the Gastineau Channel from its mouth near Fritz Cove. A gage is located at the bridge on the Back Loop Road. Minor flood stage on this gage is 12 feet, which is the high water mark that occurred on October 20, 1998. Moderate flood stage is considered 14 feet. A major flood would occur at 15.7 feet. Should a major flood occur, water would flow across the road on the Back Loop Road Bridge. Due to the flood control measures in place along the Mendenhall River drainage, it would take a flood stage of 14 feet or more to cause extensive flood problems along the floodplain of the Mendenhall River. When minor flood stage occurs on the Mendenhall however, more extensive flooding would occur on Montana and Jordan Creeks.

The Mendenhall River "oxbow" near Vintage Park is an area of concern because of its rapid erosion. When the river cuts through the oxbow, the length of the river will shorten and cause a steeper grade across the oxbow, which, in turn, will increase the velocity of the river. This increased velocity will cause the banks to erode at an increasing rate. No figures currently exist regarding the extent of the increased velocity and potential bank erosion, but it will likely extend to the back-loop bridge. Depending on the location of bends in the river and the distance from the oxbow, portions of the river will erode at a much faster rate. It will take a detailed hydrological investigation to locate these highly susceptible locations.

The headwaters of **Jordan Creek** (southeast portion of the Mendenhall Valley) originate at the base of Thunder Mountain. A USGS river gage was recently installed about 200 yards upstream of the Trout Street Bridge. Based on comparisons, the new USGS gage experiences minor flooding at 7.30 feet, moderate flooding at 8 feet, and major flooding at 9 feet. Moderate flooding or worse can impact the Jordan Creek subdivision area, as well as the businesses along the creek between Egan Drive and the airport.

There are also USGS river gages that are monitored by the National Weather Service on Lemon Creek, Nugget Creek, Duck Creek, Dorothy Creek, Salmon Creek, and Gold Creek. Flood stages have not been set for these gages yet due to a lack of historical data.

Juneau flood history

There is very little recorded information pertaining to floods in the borough. Most of the damage from major floods occurred along the Mendenhall River. The frequency of these floods, however, is impossible to determine as no estimates of flow rates are available. The principal flood problems in the area, in addition to high tides and coastal storms, are inadequate culverts and bridges which become blocked by debris and ice, developments that encroach onto and obstruct the natural floodplains, high velocity flow, and siltation of culverts. Along some of the creeks, there are large stockpiles of logs which will increase flooding if carried downstream to a constriction.

October 1998

The heaviest rainfall in the northern panhandle occurred mainly over the 19th and 20th of October in 1998. At the Juneau Airport, 6.28 inches of rain fell in 48 hours. – a record for a 2-day period. The 3-day storm total at the Juneau Airport was 6.41 inches.

Most of the flooding occurred on Tuesday, October 20th, the second day of heavy rain. Small streams swelled out of their banks in the Juneau area, and water pooled over streets and parking lots. At 11 a.m., Montana Creek rose to a stage of 17.3 feet (flood stage is 17.0 feet). At this time, flood waters over 2 feet deep covered several residential lots, and an unknown number of homes sustained water damage. Numerous mudslides occurred throughout the Juneau area and resulted in extensive damage. The worst slide completely collapsed a portion of Fritz Cove Road and removed a beachfront home from its foundation. This unoccupied home (residents were on vacation) was completely destroyed. The water receded fairly quickly during the afternoon as the rain lightened. [18] Private damages were estimated in the 1-2 million dollar range. The Governor of Alaska sought disaster-aid dollars to help repair some of the damage.

Mendenhall Lake flooding.

[18] http://testaprfc.arh.noaa.gov/pubs/newsltr/pub6/SE_flood.html

Flood Hazards Summary

Potential Damage

- Road damage and blockages
- Building damage and destruction
- Widespread general property damage
- Power interruption
- Communication interruption
- Loss of commerce
- Disruption of services

Impacts to Humans

- Drowning, Electrocution, Hypothermia
- Displaced persons/lack of shelter

Montana Creek flooding.

Flood Hazard Vulnerability

To be added

Flood Mitigation

Existing CBJ Flood Mitigation Activities

1. Lemon Creek Dredging. Just above the Old Glacier Highway bridge, there is considerable development on the north side of the creek that has experienced some flooding in the past. This flooding has been eliminated since a local firm began dredging gravel from the channel on both sides of the bridge, thereby deepening the channel. The channel now retains all levels, including the 500-year flood, within its steep banks. However, to guarantee against the occurrence of flooding, it is necessary to continue yearly dredging.

2. Gold Creek. Gold Creek, which flows through downtown Juneau, was a source of flooding prior to the construction of a flood control channel by the Corps of Engineers. However, since the completion of the project in 1958, the channel carries flood flows adequately and there have been no serious flood problems in the area.

3. Juneau/Douglas shoreline. The shoreline fronting Juneau, Douglas, and Egan Drive has been built up with rock revetments to provide protection against coastal storms and flooding.

4. Flood Hazard Ordinance. In 1987 the CBJ adopted a flood ordinance to minimize public and private losses due to flood conditions. The ordinance establishes zoning and building requirements in floodways.

5. Salmon Creek Dam Emergency Action Plan. Alaska Electric Light and Power Company reviews and revises its Emergency Action Plan annually.

6. National Flood Insurance Program (NFIP). NFIP makes federally backed flood insurance available in communities that have adopted and are enforcing floodplain management ordinances.

CBJ Flood Mitigation Ideas

Goal: Relocate and/or protect structures located in flood zones that are not eligible for NFIP.

- ***Elevation of structures in flood plains.*** Building a sustainable community requires long-term planning; evaluation of new construction with respect to future disaster damages is fundamental to establishing a disaster-resistant community.

Goal: Increase awareness of flood plains in Juneau.

- ***Installation of more USGS automated, telemetry river gages*.** The USGS automated, telemetry river gages are the chief way that the National Weather Service monitors for flooding on the streams and creeks in the Juneau Borough. While the Borough does have a fair number of USGS gages, many of them must be read manually by a trained volunteer observer. New technology does exist where these gages can be upgraded by installing satellite uplink telemetry equipment on them. This would allow for nearly instantaneous readings via the Internet.
- ***Public education*.** People that live and work in floodplains should be informed of potential dangers from flooding, including dam failures and flash flooding resulting from earthquakes.
- ***Improve and update existing flood maps***. Flood maps should be updated regularly to provide an accurate picture of flood risk in Juneau. Maps should be updated using new topographic, hydrologic and development information including dam break flood impact areas.
- ***Preparedness through the National Weather Service's StormReady Program*.** The historical weather record shows that heavy rainfall events (lasting several days) and flooding are inevitable in Juneau. The National Weather Service's StormReady program helps ensure that a community will receive the earliest possible notification of a severe weather event prior to its onset.

Goal: Reduce risk of flood damages

- ***Improve Doppler radar coverage.*** The best way to monitor for the heavy rains that could result in flooding, especially over the high elevation headwaters of streams and creeks, is through Doppler Weather Radar.
- ***Upgrade culverts and bridges to accommodate large-scale flood events..*** By preparing for a worst-case scenario, the community will be assured of safety during smaller events.
- ***Construct hillside drainage systems.*** Giving rainwaters a safe path of least resistance will not only help prevent flood damages, but may help stabilize hillsides against mass wasting.

WILDLAND FIRE

Fire is a critical feature of the natural history of many ecosystems. It is essential to maintain the biodiversity and long-term ecological health of the land. In Alaska, the natural fire regime is characterized by a return interval of 50 to 200 years, depending on the vegetation type, topography and location.

Southeast Alaska saw an increase in wildfire danger in early 2003 as a dozen wildfires occurred in the first two weeks of May[19]. Unusually warm and dry conditions led to a rare state of high fire danger in Southeast Alaska. Such conditions may become more prevalent as average temperatures rise statewide. Lending consideration to wildland fire mitigation before fire danger rises above manageable levels is an important step in maintaining a safe community.

Hazard Description and Characterization

Classifications of Wildland Fires

Prescribed Fires

Prescribed fires are ignited under predetermined conditions to meet specific objectives, to mitigate risks to people and their communities, and/or to restore and maintain healthy, diverse ecological systems.

Wildland Fire

Refers to any non-structure fire, other than prescribed fire, that occurs in the wildland.

Wildland Fire Use

Wildland fire use refers to the management of naturally ignited fires to achieve resource benefits. Wildland fire use usually allows wildland fire to function in its natural ecological role while fulfilling land management objectives.

Wildland-Urban Interface Fires

The wildland-urban interface exists wherever human development meets undeveloped wildlands. Fires that burn within that zone are referred to as wildland-urban interface fires. The potential exists in areas of wildland-urban interface for extremely dangerous and complex fire burning conditions which pose a tremendous threat to public and firefighter safety. Wildland firefighting strategy places higher value on the preservation of human property than on putting out the fire. In some cases this means that the fire is allowed to progress while firefighters protect property such as homes and other structures.

[19] http://www.juneauempire.com/stories/051103/sta_stbriefs.shtml

Wildland Fire Behavior[20]

Fuel, weather, and topography influence wildland fire behavior. Wildland fire behavior can be erratic and extreme, creating firewhirls and firestorms that can endanger the lives of the firefighters trying to suppress the blaze. The speed, direction and intensity of a fire is determined by a combination of the following factors:

Fuel

Fuel, or what the fire consumes, determines how much energy the fire releases, how quickly the fire spreads and how much effort is needed to contain the fire. The size of the fuel, its moisture content, and its density contributes to the temperature and intensity at which the fuel burns. Small diameter fuel particles have large surface area to volume ratios and their moisture contents can change rapidly with changes in temperature and relative humidity. Large pieces of fuel have low surface area to volume ratios and their moisture content will change much more slowly.

Fuel load is referred to in terms of tons/acre, and includes light fuels such as grass, shrubs and leaves; and heavy fuels such as stumps, logs and limbs. Other fuel classifications include:

> *Ground fuels – all combustible materials lying beneath the surface including deep duff, roots, rotten buried logs, and other organic material. Ground fuels feed peat fires and other smoldering, below-surface fires.*
>
> *Surface fuels – all materials lying on or immediately above the ground including needles or leaves, grass, downed logs, stumps, large limbs and low shrubs.*
>
> *Aerial fuels – all green and dead materials located in the upper forest canopy including tree branches and crowns, snags, moss, and high shrubs.*
>
> *Ladder fuels – fuels creating a bridge between surface fuels and aerial fuels.*

All of the above fuel types can be found in the Juneau area, and are of consideration when determining fire risk.

Fuel conditions leading to high fire danger include*:*

- unusually dry fuels;
- large amount of light fuel;
- fuel exposed to direct sunlight;
- fuels dried by prolonged drought;
- presence of ladder fuels;
- crown foliage dried by surface fire; and
- concentration of snags or standing dead trees.

[20] "Introduction to Wildland Fire Behavior" (Powerpoint Presentation). Available at http://www.wildlandfire2.com/ppt/s190-1.ppt.

Weather

Weather is the most variable factor in fire behavior. High temperatures and low humidity encourage fire activity while low temperatures and high humidity help retard fire behavior. Weather conditions can change quickly leading to extreme fire behavior such as firestorms or "blowups".

Wind creates very dangerous fire conditions by increasing the supply of oxygen to the fire, driving convective heat into adjacent fuels, as well as carrying away moist air and replacing it with drier air. Wind can also contribute to faster drying of fuels. Wind affects the speed and direction of a fire by pushing heat onto unburned areas and allowing for greater fire spread. Coals and embers can be carried by the wind onto unburned areas, starting spot fires.

Temperature and relative humidity can influence fuel conditions. Hot, dry conditions are ideal for wildfires, while low temperatures and high humidity can help keep a fire in check.

Weather conditions leading to high fire danger include:

- unusually high temperature and low relative humidity;
- thunderstorms above or close to the fire;
- strong wind;
- sudden changes in wind direction and velocity due to weather;
- high fast moving clouds which may indicate unusual surface winds;
- unexpected calm which may indicate wind shift;
- dust devils and whirlwinds developing; and
    - bent smoke column.

Topography

Topography directs the movement of air, which in turn affects fire behavior. When the terrain funnels air through canyons and ravines, it can lead to faster spreading. Canyons and ravines channel winds, in turn increasing wind speeds and creating more volatile fire conditions.
A fire on one side of a narrow canyon can spread to the other side of the canyon quickly due to the radiant heat from the flames.

Slopes are of considerable concern when considering fire behavior, because the flames of a fire burning up slope will preheat the fuels in front of the fire through radiation and convection, which can increase the speed and intensity of the fire. Out-of-control wildfires burning up slope are responsible for a considerable number of firefighter deaths. Such a fire can sweep uphill much faster than humans can run on foot.
Topography that may lead to high fire danger includes:

- steep slopes;
- chutes, saddles and box canyons which provide conditions for chimney effect;

- narrow canyons may increase fire spread by radiant heat and spotting;
- fire located on cape which can be impacted by sea breeze from three directions; and
- Foehn wind – a dry wind with strong downward components, characteristic of mountainous regions.

Local Wildland Fire Hazard Identification

Wildland fire risk is currently low to moderate in Juneau. Juneau's climate is typically cool with high precipitation, and Juneau has not experienced the spruce beetle outbreak that has increased fire fuel loads dramatically on the Kenai Peninsula and other areas of Southcentral Alaska. However, in any place where urban areas interface with wildlands, the possibility exists for wildfire to impact the jurisdiction. An additional consideration is the significant climate changes currently occurring in Alaska, which may in future years cause higher temperatures and lower precipitation, increasing Juneau's fire risk. In 2002, NOAA reported the driest spring on record for much of Southeast Alaska, resulting in elevated fire danger and burn bans. [21] In 2003, three wildfires in the Juneau-Douglas area were ignited due to unattended or improperly extinguished campfires.[22]

Juneau areas at risk from wildfire

Many residential areas in Juneau are at risk from wildfire due to their proximity to vegetation. Homes that do not have defensible space are difficult to defend from a wildfire. Therefore wildfire danger in Juneau is linked somewhat to residential house fire rates; it is an easy process for fire to spread quickly from a structure to nearby vegetation.

Open fires for camping, cooking, or disposal of brush are commonplace in Juneau. Such fires are usually extinguished properly or are built on sand or rocks where they cannot spread; however it is also common for fires to be improperly extinguished or built in unsafe places. Human error is often a factor in campfire-caused wildfires.

Fundamental changes in weather patterns have increased fire danger throughout Alaska, and southeast Alaska is no exception. Southeast Alaska usually receives enough precipitation to maintain low fire danger, however average temperatures have risen 8 degrees in Alaska over the last four decades and projections show this warming trend continuing over the next fifty years. Several years of lower than normal precipitation and a persistent dry weather pattern could result in high wildfire danger for Juneau. The large areas of wildland/urban interface, steep topography with narrow canyons and difficult terrain, wooden buildings, large numbers of ladder fuels and inadequate firefighting resources could prove disastrous for Juneau in the future.

[21] http://lwf.ncdc.noaa.gov/oa/climate/research/2002/may/ak0205.html
[22] http://www.wildfirenews.com/archive/052103.shtml

Wildfire Hazards Summary

Potential Damage

- Loss of structures, especially in urban /wildland interface
- Loss of resources and revenue
- Damage/loss of water supply
- Property loss
- Transportation interruption

Impacts to Humans

- Loss of life
- Respiratory damage due to smoke
- displaced persons/lack of shelter

Thick vegetation in the Juneau area, with ladder fuels showing.

Wildland Fire Hazard Vulnerability

To be added

Wildland Fire Mitigation

CBJ Wildland Fire Mitigation Ideas

Goal: Intercept potential wildland/urban interface fire danger before it becomes critical.

- ***Public education regarding defensible space around homes***. Currently in Juneau, the need for defensible space is not as critical as it is in other areas that experience extreme fire danger. However, educating the public on how to keep their homes safe in the event of a fire may help start a pattern of public awareness that may translate into long-term planning for a sustainable future.

Goal: Increase public awareness and compliance with open burning safety guidelines.

- ***Public education regarding campfires and open burning***. Campfires and other open burning are common practice around Juneau. As fire conditions change, the public should be informed of the potential consequences of careless burning. Usually the damp condition of vegetation and the likelihood of imminent rainfall makes burning relatively safe; however open burning has become a habit in the Juneau area and citizens may not realize when fire danger increases that open fires may be hazardous.

- ***Require burn permits during dry conditions***. Requiring the use of burn permits during times of higher fire danger not only helps control open burning but increases public awareness of fire danger.
- ***Monitor fire conditions and post "today's fire conditions" signs***. Changeable signage will increase public awareness of fire conditions and may encourage some to take extra precautions when burning.

Goal: Promote recognition of and prepare for the potential for wildland fire as a Juneau-area hazard.

- ***Alert and educate the public via the media if a wildfire danger threat develops***. Use the print and broadcast media to promote safe burning techniques and to notify the public when fire danger increases.
- ***Prepare for impacts resulting form excessive wildfire smoke***. Should a wildfire occur close to Juneau, residents may feel the effects of the smoke and soot in the air. Increased respiratory difficulties may occur, especially in high-risk populations such as the ill or elderly. Large amounts of smoke may also interrupt air traffic in the area.

TSUNAMIS AND SEICHES

Alaska is the site of 35 of the Pacific coast's 63 historical tsunamis. The tsunamis of 1964 were among the most damaging historical tsunami events worldwide.[23] Southeast Alaska has been struck by ten of Alaska's historical tsunamis, about half of which were damaging. The tsunami with the highest wave height ever recorded occurred in Southeast Alaska, at Lituya Bay in 1958. Tsunamis in Alaska have destroyed settlements such as Kodiak and Valdez, and structures such as Scotch Cap lighthouse, and have caused many deaths and extensive property damage. Although Juneau is sheltered from the open ocean, its topography and geologic conditions leave it vulnerable to locally-generated tsunamis and seiches. All coastal areas are vulnerable to tsunamis.

Hazard Description and Characterization

Tsunamis are traveling gravity waves in water, generated by a sudden vertical displacement of the water surface. They are typically generated by an uplift or drop in the ocean floor, seismic activity, volcanic activity, meteor impact, or landslides (above or under sea in origin).

Most tsunamis are small and are only detected by instruments. Tsunami damage is a direct result of three factors: inundation (extent the water goes over the land), wave impact on structures and coastal erosion.

Types of Tsunamis

Volcanic tsunamis
There has been at least one confirmed volcanically triggered tsunami in Alaska. In 1883, a debris flow from the Saint Augustine volcano triggered a tsunami that inundated Port Graham with waves 30 feet high. Other volcanic events may have caused tsunamis but there is not enough evidence to report that conclusively. Many volcanoes have the potential to generate tsunamis.

Seismically-generated local tsunamis
Most seismically-generated local tsunamis have occurred along the Aleutian Arc. Other locations include the back arc area in the Bering Sea and the eastern boundary of the Aleutian Arc plate. They generally reach land 20 to 45 minutes after starting.

Landslide-generated tsunamis
Submarine (underwater) and subaerial (surface) landslides can generate large tsunamis. Landslide-generated tsunamis are responsible for most of the tsunami deaths in Alaska because they allow virtually no warning time.

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[23] http://wcatwc.gov/tsustats.pdf

Subaerial landslides generate larger tsunamis because more kinetic energy is associated with such an event. An earthquake usually triggers this type of landslide and the wave generated by it is usually confined to the bay or lake of origin. One earthquake can trigger multiple landslides and landslide-generated tsunamis. Low tide can exacerbate the threat of submarine landslides because low tide leaves part of the water-saturated sediments exposed without the support of the water. Loading on river deltas from added weight such as trains or a warehouse or added fill can add to an area's instability.

Landslide-generated tsunamis occur not only in ocean bays, but in lakes as well. Tsunamis generated by landslides in lakes occur more in Alaska than any other part of the U.S. They are associated with the collapse of deltas in deep glacial lakes as well as glacial calving.

Seiches

A seiche is a wave that oscillates in partially or totally enclosed bodies of water. A seiche can last from a few minutes to a few hours as a result of an earthquake, underwater landslide, atmospheric disturbance or avalanche. The resulting effect is similar to bathtub water sloshing repeatedly from side to side. The reverberating water continually causes damage until the activity subsides. The factors for effective warning are similar to a local tsunami, in that the onset of the first wave can be a few minutes, giving virtually no time for warning. Seiches were witnessed in lakes in the Skagway area during and after the large earthquake of 2002.

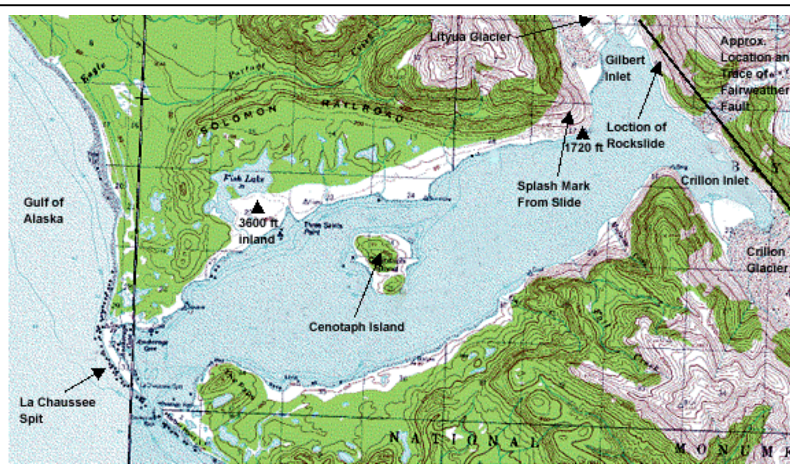
Local Tsunami Hazard Identification

The protected communities of southeast Alaska such as Juneau are at low risk for damage from a distant-source tsunami; however landslide-generated tsunamis are a significant hazard, especially when combined with the risk of earthquake in the region. Earthquakes can trigger landslides, which can in turn create a tsunami.

<u>Relevant Alaska Tsunamis</u>

1958 Lituya Bay Tsunami

In July 1958, in Lituya Bay (Glacier Bay National Park), a large earthquake induced a giant landslide that ran into the head of the bay and generated a tsunami. The wave washed up a mountainside on the opposite side of the bay to a height of more than 1,720 feet. Two fishing vessels anchored in the bay sank, killing two people and a third boat was washed over the La Chaussee Spit. The earthquake actually triggered at least eight separate local tsunamis. Three fatalities were associated with the tsunami occurring in Yakutat Bay. Lituya Bay is a known tsunami prone area as there have been three other fatal landslide generated tsunamis.



Lituya Bay tsunami damage.

1994 Skagway Tsunami

The 1994 Skagway tsunami was a landslide-generated tsunami that caused one fatality and over $25 million in damages. This event was predicted somewhat by a 1972 U.S. Geological Survey study that addressed Skagway's vulnerability to landslide-generated tsunamis. The study concluded that a large landslide-generated tsunami was likely in Skagway and would cause a significant hazard to the city. The study recommended that the area be studied in detail to better understand the threat and possible mitigation activities. The recommended assessments and studies were not performed.

Tsunami Hazard Summary

Potential Damage

- Road blockages and damage
- Damage/destruction of structures
- Widespread general property damage
- Power interruption
- Communication interruption
- Property loss

Hazards to Humans

- Drowning, electrocution, and hypothermia
- Displaced people/lack of shelter

Tsunami damage at Seward, Alaska

Tsunami Hazard Vulnerability

To be added

Tsunami Mitigation

CBJ Tsunami Mitigation Ideas

Goal: Promote recognition of tsunamis as a potential Juneau-area hazard.

- ***Public education.*** Educate residents in the impact areas on the threat, how to monitor for tsunami warnings, and actions to take during high risk times.

Goal: Identify potential sources of landslide-induced tsunamis in the Juneau area.

- ***Local study identifying potential tsunami sources.*** Since even landslide-generated tsunamis can travel significant distances, a study should be performed on the Juneau region to determine areas of concern. Such a study will also be useful in the future as additional development continues in the region.

Goal: Reduce vulnerability to tsunamis.

- ***Make Juneau TsunamiReady.*** The TsunamiReady Community program promotes tsunami hazard preparedness as an active collaboration among federal, state and local emergency management agencies, the public, and the NWS tsunami warning system. This collaboration supports better and more consistent tsunami awareness and mitigation efforts among communities at risk.
- ***Study the effectiveness of raising all harbor breakwaters and building seawalls.*** Research can help determine whether such projects would effectively mitigate the hazard.
- ***Ensure that schools and public buildings have a means to receive severe weather and tsunami warnings***; i.e. NOAA Weather Radio

VOLCANOES

Alaska is home to 41 historically active volcanoes stretching across the entire southern portion of the State from the Wrangell Mountains to the far Western Aleutians. "Historically active" refers to actual eruptions that have occurred during Alaskan historic time, in general the time period in which written records have been kept; from about 1760. An average of 1-2 eruptions per year occur in Alaska. In 1912, the largest eruption of the 20th century occurred at Novarupta and Mount Katmai, located in what is now Katmai National Park and Preserve on the Alaska Peninsula.

While Juneau is at low risk for experiencing the primary effects of a volcanic eruption, the large numbers of volcanoes in Alaska place Juneau at risk for experiencing secondary effects of eruptions, such as ash fall. Several relatively recent volcanic eruptions have resulted in ash fall throughout the state, disrupting air traffic and, in extreme cases, making living conditions horrific and causing significant environmental damage even in areas hundreds of miles from the eruption.

Hazard Description and Characterization

A volcano is a vent at the Earth's surface through which magma (molten rock) and associated gases erupt, and also the landform built by effusive and explosive eruptions.

Volcanic Ash

Volcanic ash, also called tephra, is fine fragments of solidified lava ejected into the air by an explosion or rising hot air. Ash fall is the most significant volcanic hazard to Juneau because, unlike other secondary effects of eruptions such as lahars and lava flows, ash fall can travel thousands of miles from the site of the eruption.

Mount Wrangell, the shield volcano on the right skyline, is the only volcano in the Wrangell Mountains to have had documented historical activity consisting of several minor eruptions in the early 1900's. Image courtesy B. Cella, U.S. National Park Service.

Ash fragments range in size, with the larger falling nearer the source. Away from the eruption site, the primary hazards to humans are decreased visibility and inhalation of fine, abrasive ash. Ash will also interfere with the operation of mechanical equipment. Aircraft are of special concern because of the disastrous affects volcanic ash can have on airplane engines.

Ash clouds have caused catastrophic failure in airplane engines, most notably in 1989 when KLM Flight 867, a 747 jetliner, flew into an ash cloud from Mt. Redoubt's eruption and subsequently experienced flameout of all four engines. The jetliner fell 13,000 feet before the flight crew was able to restart the engines and land the plane safely in Anchorage. The significant trans-Pacific and intrastate air traffic in Alaska, directly over or near 41 potentially active volcanoes, has necessitated development of a strong communication and warning link between AVO, other government agencies with responsibility in aviation management, and the airline and air cargo industry.

Local Volcano Hazard Identification

The responsibility for hazard identification and assessment for the active volcanic centers of Alaska falls to the Alaska Volcano Observatory and its constituent organizations (USGS, DNR/DGGS, and UAF/GI). AVO is in the process of publishing individual hazard assessments for each active volcano in the State. As of 2002, published or in-press hazard assessments cover the following volcanoes: Hayes, Spurr, Redoubt, Iliamna, Augustine, the Katmai Group, Aniakchak, Shishaldin, Akutan, and Makushin. Additional reports for Shishaldin, Kanaga, Great Sitkin, Westdahl, Dutton, Okmok are expected within the next year or two. Each report contains a description of the eruptive history of the volcano, the hazards they pose and the likely effects of future eruptions on populations, facilities, and ecosystems.

Alaska's Active Volcanoes

Alaska contains 80+ volcanic centers and is at continual risk for volcanic eruptions. The AVO's *Catalog of the Historically Active Volcanoes of Alaska* states that "Mount Dutton experienced severe volcano-seismic crises in 1984 and 1988 that resulted from the near-surface movement of magma yet did not yield an eruption. Iliamna volcano experienced similar unrest in 1996."

Most of Alaska's volcanoes are far from settlements that could be affected by lahars, pyroclastic flows and clouds, and lava flows; however ash clouds and ash fall have historically caused significant impact on human populations. "When volcanoes erupt explosively, high –speed flows of hot ash (pyroclastic flows) and landslides can devastate areas 10 or more miles away, and huge mudflows of volcanic ash and debris (lahars) can inundate valleys more than 50 miles downstream. . . Explosive eruptions can also produce large earthquakes. . . the greatest hazard posed by eruptions of most Alaskan volcanoes is airborne dust and ash; even minor amounts of ash can cause the engines of jet aircraft to suddenly fail in flight."[24]

Juneau Vulnerability

Although Juneau itself is far from any active volcanoes, many of the volcanoes in Alaska and British Columbia, Canada, are capable of producing eruptions that can affect Juneau and the rest of southeast Alaska. Since most active Alaskan volcanoes are far enough from settlements that the resulting pyroclastic flows and lahars are not a significant danger, the primary concern from volcanic eruptions in Alaska is the danger posed to residents and the environment from significant ash falls. A large ash plume also has the capability of shutting down air operations,

[24]http://geopubs.wr.usgs.gov/fact-sheet/fs075-98

which would leave Juneau dependent upon barge traffic for supplies and assistance. Since tephra is damaging to engines, it is possible that not even barges would be available to deliver supplies.

An ash fall like the one experienced at Kodiak Island in 1902 would undoubtedly be devastating to the city. Even if no direct impacts of an eruption affect Juneau, the city might still feel the strain on resources should other hub communities be significantly affected by volcanic eruption. An eruption of significant size in southcentral Alaska will certainly affect air routes, which in turn affects the entire state.

Juneau is not at risk from volcano-generated tsunamis; however the increased possibility of earthquakes that accompany volcanic eruptions puts Juneau at risk for landslides, avalanches and seiches in addition to ash fall. Economic impacts are also a concern; a large eruption that significantly impacts the Anchorage area will certainly have repercussions for Juneau as well, even if none of the primary volcanic effects reach the southeast.

Juneau has been affected by ash fall from several historic volcanic events. The 1902 Novarupta eruption produced an ash cloud that grew to thousands of miles wide, reaching as far north as Fairbanks and throughout southeast Alaska and Canada. Dangerous acid rain conditions were experienced as far away as Vancouver, British Columbia as a result of this eruption. At least seven deposits of volcanic ash have been identified by geologists in Alaska that approach or exceed the volume of ash ejected by Novarupta, indicating that even though such eruptions are rare, they are a relatively regular occurrence in Alaska[25].

The 1989-90 eruption of Mt. Redoubt seriously effected the populace, commerce, and oil production and transportation throughout the Cook Inlet region and air traffic as far away as Texas. Total estimated economic costs are $160 million, making the eruption of Redoubt the second most costly in U.S. history.[26] Mt. Spurr's 1992 eruption brought business to a halt and forced the closure of Anchorage International Airport for 20 hours. Communities 400 miles away reported light dustings of ash.

In 1992, another eruption series occurred, resulting in three separate eruption events. The first, in June, dusted Denali National Park and Manley Hot Springs with 2mm of ash – a relatively tame event. In August, the mountain again erupted, covering Anchorage with ash, bringing business to a halt and forcing officials to close Anchorage International Airport for 20 hours. St. Augustine's 1986 eruption caused a similar disruption in air traffic.

[25] http://geopubs.wr.usgs.gov/fact-sheet/fs075-98
[26] http://www.avo.alaska.edu/avo4/atlas/volc/redou/activity.htm

Volcano Hazards Summary

Potential Damage

- General property damage (i.e. to engines from tephra)
- Structure damage from ash loading
- State/regional transportation interruption
- Loss of commerce
- Contamination of water supply

Impacts to Humans

- Respiratory problems from airborne ash
- Displaced persons/lack of shelter
- Personal injury

Ash fall from recent Alaska volcanic eruptions.

Volcano Hazard Vulnerability

To be added

Volcano Mitigation

Volcanoes are not usually considered to be a significant threat to the Juneau area since there are no nearby active volcanic centers; however the probability of a volcanic eruption elsewhere in the state makes it important for Juneau to consider how it might be affected by such an event. Effects can range from the inconvenient – a few days of no air traffic – to the disastrous – heavy, debilitating ashfall throughout the state including the southeast, forcing the community to be completely self-sufficient.

CBJ Volcano Mitigation Ideas

- ***Have an effective plan in place to utilize in case of lifeline failure***. The CBJ and its citizens should be prepared to be completely self-sufficient for at least several days in the case of a widespread transportation shutdown. Such a plan would be useful for mitigation of a large number of hazards.
- ***Stay aware of volcano activity throughout the state***. Current monitoring of volcanic activity is very accurate. The CBJ should be involved in volcanic monitoring to the point that it will be aware of an imminent event that may affect Juneau.

- ***Evaluate structures at risk for heavy load collapse***. Such an evaluation will also reveal which structures are in danger of collapsing under heavy snow loads. Structures can then be upgraded or retrofitted to safe loadbearing capacity.
- ***Shelter/evacuation plan***. Evacuation may be difficult in case of large ash fall as engines may not be operable. Such a plan will be useful for mitigation of a large number of hazards.
- ***Evacuate at-risk population.*** Given warning of a large volcanic event, people with high risk of respiratory failure should be evacuated to a safe distance.

AIR TRANSPORTATION

Juneau can be significantly affected by air transportation accidents. Since there are no roads into the city, the airport is the only source of quick transportation in or out of the region. Additionally, the location of the Juneau International Airport, hazardous terrain, and the region's unpredictable weather make air transportation in Juneau inherently dangerous. Difficult and inaccessible terrain hinders response to any air transportation accident that may occur. Flight paths close to the city are typically over populated areas with little margin for error.

Hazard Description and Characterization

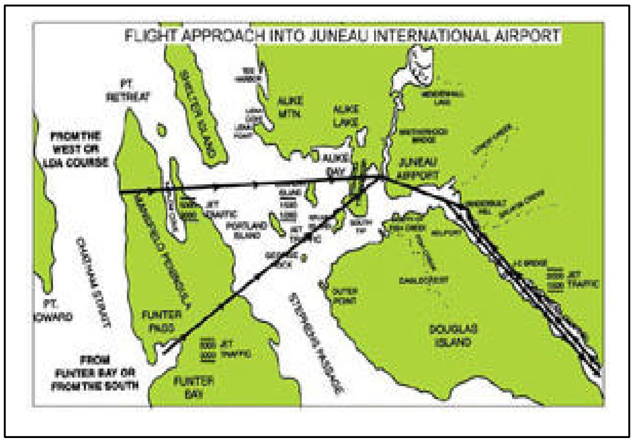
For the purposes of this plan, air transportation hazards are those that have the potential to cause significant loss of human life. The causes of airplane accidents and crashes vary to include poor or improper maintenance, terrorism or sabotage, weather, pilot error, and any number of other factors that affect aircraft operations. Large aircraft can carry hundreds of people and can therefore result in hundreds of fatalities and injuries in the event of a crash. An airplane crash in a populated area can also result in additional fatalities and injuries.

Local Air Transportation Hazard Identification

Much of the following information is from "Juneau International Airport – Safety concerns and estuarine habitat values" by Holly Rhoden, Colin Conerton, Chris Frank, Natalie Hale, and Josh Finley. Available at http://www.uaf.edu/seagrant/nosb/papers/2003/tempest-airport.html.

The Juneau International Airport (JIA) is plagued by safety hazards including hazardous terrain, inclement weather, and bird strikes. The JIA is nestled in a narrow valley between tall, steep glacial mountain peaks at the convergence of two glacial valleys: the Gastineau Channel and the Mendenhall Valley. The footprint of the JIA is on estuary wetlands on the Mendenhall River delta. The delta is one of the richest bird habitats in the region and has been preserved as the Mendenhall Wildlife Refuge.

Aviation Navigation



The Juneau International Airport is located in a challenging and potentially dangerous region for airplanes. Located nine miles west of downtown Juneau, the airport spans 662 acres of estuarine land. The JIA is uniquely situated on wetlands created by glacial river deposits in a sediment-laden fjord. Its elevation is rising due to glacial isostatic rebound and possibly tectonic forces. The present location of JIA is difficult for pilots to navigate. The terrain, wildlife, and weather associated with the airport create the need to plan for expansion or move the facility entirely.

Terrain

The high terrain surrounding the JIA makes approach routes into the JIA difficult. Approaching from the west to land on the single runway, pilots navigate around or over numerous mountains with heights of up to 4,228 feet. When descending from the west, a small miscalculation can be disastrous. On September 4, 1971, before navigational aids like the Global Positioning System (GPS) were available, such a miscalculation caused a Alaska Airlines Boeing 727 jet to crash into the Chilkat Mountain Range, killing all 111 people on board.

Once a plane navigates over the surrounding mountains, the 573 foot high Mendenhall Peninsula poses a serious obstacle to a plane on final approach. The peninsula is a major navigational obstacle to pilots and must be avoided to the south. In descent, the aircraft must turn sharply to the right at speeds of 90-150 MPH at altitudes of less than 600 feet, and then correct itself so that it is in a straight path towards the runway.

In the event of a missed approach on runway 26, planes have a straight escape route to a comfortable altitude of 5000 feet. However, on a missed approach to runway 8, the emergency route is much more difficult. Larger aircraft must negotiate the mountains that surround the airport and Gastineau Channel. To avoid the surrounding terrain, not only must jets use tremendous engine power, but they must also climb at very steep angles in very short amounts of time. During this ascent, the deck angles are such that forward and downward visibility become extremely limited.

Wind

The Gastineau channel acts as a wind funnel, directing gusts directly towards the airport. Most planes approach JIA from the west due to prevailing southeast winds.

When landing in westerly winds, aircraft coming into JIA use the more desirable easterly approach. Approaches from the west are surrounded by tall mountains, providing little room for lateral movements in the event of missed landings.

Lights

No medium intensity approach lights with runway alignment indicators (MASLR) are presently installed on the easterly approach runway (Runway 8). MASLR enhance safety in non-precision landings and improve night visual approaches. Without MASLR on Runway 26, many smaller aircraft not equipped with GPS cannot land in low visibility.

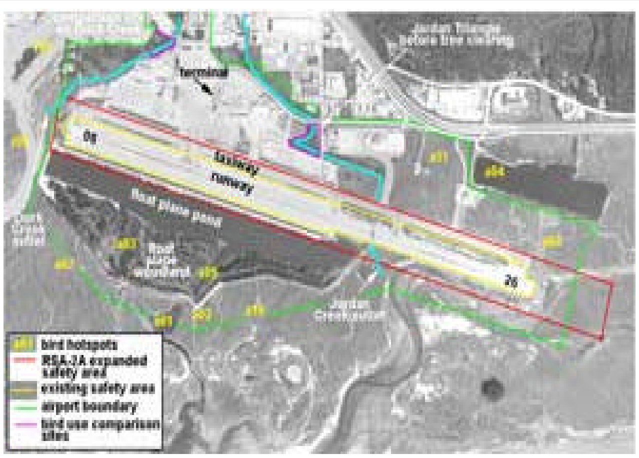
Weather

Weather conditions at JIA are a frequent problem and interfere with many flights. The average number of days with dense fog at JIA over a 30 year period was 20.6 days according to the National Weather Service. On average, there are 12.3 days with less than a quarter mile of visibility between August and December. In 2002, twenty-two days of dense fog that created hazardous flying conditions were experienced in these months due to lack of strong southeasterly winds and rain. During winter months, darkness prevails and warming during the day does not compensate for nighttime cooling and the air is unable to dry out, creating a pattern of daily fog that can last for days at a time.

Bird Strikes

The abundance of bird life found on the Mendenhall Wildlife Refuge adjacent to JIA makes the potential for bird strikes very high. Bird strikes at JIA have involved both jets and light aircraft. Of the six reported strikes at JIA that caused damage to aircraft, five of them involved jets while only one involved a light aircraft. The potential for loss of many human lives is greater in the event of a bird strike to a commercial jet than in a strike to a light aircraft.

While bird strikes can be a problem when a bird merely strikes the body of the aircraft, the biggest safety concern is that of birds being pulled into the jet's engines. While there are Federal Aviation Regulations for jet engines' capacity to ingest birds, they are not sufficient for some of the species that reside near JIA. Such species include the Canada goose, great blue heron, greater white-fronted geese, bald eagles, trumpeter swans, and tundra swans. Standard engine regulations were not written to suit the JIA environment, therefore it is likely that plane engines would not be able to withstand ingestion of such large birds.



In spite of the large bird population adjacent to the airport, bird strikes are not a common occurrence in Juneau. There were 21 reported bird strikes from 1990-present. Fifteen of the strikes resulted in no damage while three caused minor damage and three more caused serious damage to the aircraft. Thirteen of these strikes were to jets, two causing minor damage and two causing substantial damage.

However, it should be noted that not all bird strikes are reported. According to the Bird Strike Committee USA, pilots fail to record an estimated 80% of bird strikes to U.S. civil aircraft. If these statistics apply to the JIA, as many as 100 bird strikes may have actually occurred from 1990-present. No injuries resulting from bird strikes to aircraft have been reported.

Local Air Transportation Accident History

Numerous small and light aircraft crashes and accidents have occurred in the CBJ area. Usually these accidents, while tragic, do not result in the loss of many human lives since light aircraft typically can carry only a few people.

The September 4, 1971 crash of an Alaska Airlines jetliner resulted in 111 deaths. The aircraft crashed into the surrounding mountains while executing an approach into Juneau due to a premature start of final descent by the pilot. The National Transportation Safety Board (NTSB) determined the probable cause of the accident was a display of misleading navigational information.

Air Transportation Hazards Summary

Potential Damage

- Transportation interruption
- Infrastructure damage (if occurring in populated area)

Impacts to Humans

- Loss of life
- Injuries

Wreckage of the 1970 Alaska Airlines crash near Juneau.

Air Transportation Hazard Vulnerability

To be added.

Air Transportation Hazard Mitigation

To be added.

Section 4:
Mitigation Strategy

Mitigation Strategy Development

This section of the plan outlines the CBJ's overall strategy to reduce its vulnerability to the effects of the hazards studied. Currently the planning effort is limited to the three hazards determined to be of the most concern; avalanche, landslide, and downtown Juneau fire; however the mitigation strategy will be regularly updated as additional hazard information is added and new information becomes available.

Overview

Evaluating mitigation options is a difficult task. The Planning Team must balance the effectiveness of the mitigation action against cost, public opinion, affects on the environment, feasibility, and many other factors. Because of gaps in available data, any quantitative measurement will exhibit a certain amount of ambiguity. The Planning Team chose to use a system that would apply all available data while at the same time illustrating where data is insufficient to apply to the mitigation option as a criteria.

Mitigation action items were identified by the Planning Team through brainstorming, outside contributions, and public meetings. The Planning Team used the following information (Pages 112 through 114), which lists each mitigation option, its cost, estimated timeframe, responsible agency, and potential sources of funding, to evaluate and prioritize each mitigation action item.

The Planning Team then chose the STAPLE+E method to establish ratings for each hazard based on the best available data. The STAPLE+E method is a planning tool recommended by FEMA the helps planners apply their existing knowledge and available data to each mitigation option during the prioritization process. The STAPLE+E method is described in more detail in Table 18 on page 115. The Planning Team then applied a rating of Significantly Adverse, Insignificant, Significantly Beneficial, or Unknown to each option. More detailed explanations of these ratings are found in Table 19 on page 116. To make this rating system easier to understand, the Planning Team applied a numerical value to each rating, as shown in Table 23 on page 120.

Since significant gaps in data make it impossible to accurately rate mitigation options solely based on the results of such tabulations, the Planning Team created a Mitigation Action Plan outlining progressive steps the CBJ can take to apply the recommended mitigation options. The Mitigation Action Plan is comprised of mitigation options that the CBJ can utilize quickly and easily, with minimal financial investment, until more comprehensive information regarding large-scale mitigation options can be obtained. The Mitigation Action Plan is designed in a way that enables the CBJ to enact whichever mitigation options are currently possible for it to accomplish, as well as easily update the action plan as circumstances and available data changes.

Table 15 Avalanche Mitigation Options

HAZARD:	Avalanches

MITIGATION ACTIONS	RESPONSIBLE AGENCY	COST	POSSIBLE FUNDING SOURCES	TIMEFRAME
Public education: • Continue to educate regarding avalanche hazard • Promote mitigation plan effort • Encourage homeowners to undertake mitigation actions for their own homes	CBJ	Staff time	CBJ EMPG PDMG	Ongoing
Utilize appropriate methods of structural avalanche control. Possible methods include: • Snow fences • Diversion/containment structures • Reforestation	CBJ, supported by State of Alaska DOT (in some areas)	Avalanche system design, purchase of materials,cost of installation	CBJ PDMG EMPG	1-2 years; permanent when complete although may require light maintenance
Establish regular avalanche hazard evaluation and forecasting during the winter months.	CBJ	Cost of staff position or outside avalanche specialist/fore-casting service	CBJ	1 year
Progressively buy out homes in high hazard zones	CBJ	Market value of all homes in avalanche zones	CBJ HMGP PDMG	10-50+ years
Prohibit all new construction in hazard zones	CBJ	None; however staff time is required for enforcement	CBJ	1 year
Attach “high hazard zone” designation to titles of properties	CBJ	Staff/ administration time	CBJ	1 year

Table 16 Landslide Mitigation Options

HAZARD:	Landslide

MITIGATION ACTIONS	RESPONSIBLE AGENCY	COST	POSSIBLE FUNDING SOURCES	ESTIMATED TIMEFRAME
Update CBJ mapping to reflect high hazard and moderate hazard areas as determined in CBJ-funded studies	CBJ	Staff time	CBJ EMPG HMGP	3-5 years
Utilize existing drainage system above Gastineau Avenue	CBJ	Staff time to investigate state of drainage systems; future maintenance costs	CBJ	Immediately – 1 year
Prohibit removal of vegetation in landslide areas	CBJ	Staff and administrative time	CBJ	1 year
Restrict construction in landslide zones	CBJ	Staff and administrative time	CBJ	1 year
Buy out of affected properties	CBJ	Market value of all homes in hazard zones, staff time	CBJ EMPG PDMG	10-50+ years
Structural reinforcement of unstable slopes	CBJ with support from AkDOT in some areas	Staff time; future main-tenance costs	CBJ State of AK EMPG PDMG	1-10 years
Thorough geological mapping of soils and slopes	CBJ with support from State of AK in some areas	Staff time		3-10 years
Link “high hazard” designation to titles of properties	CBJ	Administrativ e/staff time	CBJ	1 year
Require owners to notify renters of hazard prior to occupancy	CBJ	Administrativ e/staff time	CBJ	1 year

Table 17 Downtown Fire Mitigation Options

HAZARD:	Downtown Fire

HIGH PRIORITY ACTIONS	RESPONSIBLE AGENCY	COST	POSSIBLE FUNDING SOURCES	ESTIMATED TIMEFRAME
Code changes: Mandatory sprinklers for structures in hazard zone	CBJ	Staff time for future enforcement	CBJ USFA HMGP PDMG	1 year
Restrict open burning/campfires in hazard area	CBJ	Staff time	CBJ	1 year
Increase code enforcement.	CBJ	Staff time	CBJ	Ongoing
Update downtown fire hazard zone mapping to more accurately reflect highest hazard areas	CBJ	Staff time	CBJ HMGP USFA	1 year
Provide incentives for business owners to incorporate fire protection measures	CBJ	Staff time	CBJ USFA	1-3 years
Restrict smoking in the downtown area	CBJ	Staff time; future enforcement	CBJ	1 year
Place cigarette receptacles in strategic location to discourage careless disposal	CBJ	Cost of receptacles, staff time for installation and future maintenance	CBJ	1 year

Each option was evaluated by the Planning Team for its feasibility utilizing the STAPLE+E method to evaluate each mitigation options. STAPLE+E is comprised of the following evaluation categories:

Table 18 STAPLE+E Evaluation Criteria

	Evaluation Category	Details	Considerations
S	Social	Mitigation actions are acceptable to the community if they do not adversely affect a particular segment of the population; do not cause relocation of lower income people; and if they are compatible with the community's social and cultural values.	• Community acceptance • Adversely affects segment of the population
T	Technical	Mitigation actions are most effective if they are technically feasible; provide long-term reduction of losses; and have minimal secondary adverse impacts.	• Technical feasibility • Long-term solution • Secondary impacts
A	Administrative	Mitigation actions are easier to implement if the jurisdiction has the necessary staffing and funding, and can provide the necessary maintenance requirements.	• Staffing (sufficient number of staff and training) • Funding allocated • Maintenance and operations
P	Political	Mitigation actions can truly be successful if all stakeholders have been offered an opportunity to participate in the planning process and if there is sufficient political and public support for the action.	• Political support • Local champion or plan proponent (respected community member) • Public support (stakeholders)
L	Legal	For proper implementation and enforcement of a mitigation action, it is critical that the jurisdiction or implementing agency have the legal authority to do so.	• State authority • Existing local authority • Action potentially subject to legal challenge by opponents (stakeholders who would be negatively affected)

E	Economic	Budget constraints can significantly deter the implementation of mitigation actions, therefore it is important to evaluate whether an action is cost-effective, if there are available funding sources, and if the action contributes to other community economic goals.	• Benefit of mitigation action • Cost of mitigation action • Contributes to economic goals • Outside funding required
E	Environmental	Sustainable mitigation actions that do not have an adverse effect on the environment, that comply with federal, state and local environmental regulations, and that are consistent with the community's environmental goals, have mitigation benefits while being environmentally sound.	• Affects land/water bodies • Affects endangered species • Affects hazardous materials and waste sites • Consistent with community's environmental goals • Consistent with Federal laws

Once the mitigation actions were evaluated using STAPLE+E, the Planning Team established ratings for each action using the following guidelines:

Table 19 STAPLE+E Ratings

Evaluation Category	**Rating**			
	Significantly Adverse (SA)	**Insignificant (I)**	**Significantly Beneficial (SB)**	**Unknown (U)**
Social	Mitigation action is not acceptable to the community because it may adversely affect a particular segment of the population; or there is potential to cause relocation of lower income people; or it is not compatible with the community's social and cultural values.	No conflict or mitigation actions are not expected to result in significant effects on social and cultural issues.	Mitigation action is acceptable to the community because it significantly benefits the community as a whole; and promote the community's social and cultural values.	The effects of the mitigation action on social and cultural issues are unknown.

Technical	Evidence suggests that mitigation action is not technically feasible; or does not provide long-term reduction of losses; or has adverse secondary impacts.	No conflict or mitigation actions are not expected to result in significant effects on technical issues.	Evidence suggests that the mitigation action is particularly easy to implement, provides long-term reduction of losses, or has secondary benefits.	The effects of the mitigation action on technical issues are unknown.
Administrative	Evidence suggests that staffing and/or funding will be insufficient; or maintenance requirements will be beyond community's capabilities; such that it jeopardizes the success of the mitigation action.	No conflict or mitigation action is not expected to result in significant effects on administrative issues.	Evidence suggests that there is sufficient staffing, funding, and maintenance capabilities to meet the requirements for the mitigation action to be successful.	The effects of the mitigation action on administrative issues are unknown.
Political	Evidence suggests that most stakeholders are strongly opposed to the proposed mitigation action or there may be significant political opposition to the mitigation action.	No conflict or mitigation actions are not expected to result in significant effects on political issues.	Evidence suggests that most stakeholders strongly support the mitigation action.	The effects of the mitigation action on political issues are unknown.
Legal	Proper implementation and enforcement of the proposed mitigation action is jeopardized due to a lack of jurisdiction or legal authority to do so.	No conflict or mitigation actions are not expected to result in significant effects on legal issues.	Sufficient jurisdiction and/or legal authority exists such that proper implementation and enforcement of the proposed mitigation action is likely to be successful.	The effects of the mitigation action on legal issues are unknown.

Economic	Evidence suggests that budget constraints will significantly deter the implementation of mitigation actions. Mitigation action is highly cost prohibitive.	No conflict or mitigation actions are not expected to result in significant effects on economic issues.	Mitigation action is significantly cost effective; or will result in significant economic benefit for the community.	The effects of the mitigation action on economic issues are unknown.
Environmental	Proposed mitigation action has an adverse effect on the environment; or mitigation does not promote environmental sustainability; or does not comply with federal, state, or local environmental regulations; or is not consistent with the community's environmental goals.	No conflict or mitigation actions are not expected to result in significant effects on environmental issues.	Mitigation action may have a beneficial effect on the environment, promotes environmental sustainability, complies with federal, state, and local environmental regulations, and is consistent with the community's environmental goals.	The effects of the mitigation action on environmental issues are unknown.

Using the best available data, the Planning Team established the following ratings for the mitigation action items for avalanches, landslides, and downtown Juneau fire. Ratings of "unknown" indicate a lack of available data with which to accurately rate the mitigation option in that category. Only mitigation options with essentially no cost can be accurately assessed at this time. The data necessary to conduct an accurate cost-benefit analysis of mitigation options that require significant investments is not currently available, but will be added as resources allow further study. Consequently, some mitigation options that were determined by the planning team to be the most desirable, such as structural control of avalanches and landslides, require further study before feasibility can be determined.

The feasibility of mitigation options for avalanche- and landslide- affected properties is undetermined at this time. The CBJ does not currently have the capability or the resources to create an avalanche system design or to conduct soil and slope mapping and structural reinforcement design, so it is not possible to compare the costs and benefits of structural avalanche and landslide control against estimated costs of a buyout.

Table 20 Avalanche STAPLE+E Ratings

Mitigation Action Item	S	T	A	P	L	E	E
Public education	I	I	SB	SB	I	U	I
Structural avalanche control	SB	SB	I	SB	I	U	I
Avalanche forecasting	I	I	U	U	I	U	I
Progressive buyout	I	U	U	U	SB	U	SA
Prohibit new construction	SB	SB	SB	U	SB	I	I
Update existing structures to impact load standards	U	U	U	U	U	U	I
"High hazard" designation	I	SA	I	SA	I	U	I

Table 21 Landslide STAPLE+E Ratings

Mitigation Action Item	S	T	A	P	L	E	E
Update mapping to include all of CBJ	SB	U	U	I	I	U	I
Utilize Gastineau Avenue drainage system	SB	SB	SB	SB	U	SB	I
Prohibit removal of vegetation	SB	SB	SB	I	I	SB	SB
Prohibit new construction	SB	SB	SB	U	SB	I	I
Progressive buyout	I	U	U	U	SB	U	SA
Structural reinforcement of unstable slopes	SB	SB	I	SB	I	U	I
Mapping of slopes and soils	SB	U	U	I	I	U	I
"High hazard" designation	I	SA	I	SA	I	U	I
Require notification of renters	SA	U	I	U	I	I	I

Table 22 Downtown Fire STAPLE+E Ratings

Mitigation Action Item	S	T	A	P	L	E	E
Mandatory sprinklers in downtown buildings	I	SB	I	U	I	U	I
Restrict open burning	I	SB	U	U	SB	SB	SB
Increase/update code enforcement	U	SB	SB	U	SB	SB	I
Update hazard zone mapping	U	U	SB	U	I	U	I
Incentives for fire protection measures	I	U	SB	I	I	SB	I
Restrict smoking in downtown area	SB	SB	SB	U	U	I	I
Receptacles for cigarette butts	SB	SB	SB	U	I	I	SB

Mitigation Action Item Ratings

The ratings for each hazard were then calculated using the following scale:

SB = 1

I = 0

SA = -1

Ratings of "U" were left in place and not applied to the numerical calculations. As such, they do not have any effect of the overall score of each hazard; however they do show a deficiency in data that, when overcome, may affect the overall priority of the mitigation action. Therefore the results of these calculations should only be looked on as preliminary data and should not be applied to long-term planning efforts until the data that is lacking can be applied.

Using the above numerical scale, the hazard scores were calculated as follows:

Table 23 Numerical Ratings

Avalanche Mitigation Action Item	S	T	A	P	L	E	E	Final Score
"High hazard" designation	0	-1	0	-1	0	U	0	-2
Progressive buyout	0	U	U	U	1	U	-1	0
Avalanche forecasting	0	0	U	U	0	U	0	0
Update existing structures to impact loads	U	U	U	U	U	U	0	0
Public education	0	0	1	1	0	U	0	2
Structural avalanche control	1	1	0	1	0	U	0	3
Prohibit new construction	1	1	1	U	1	0	0	4
Landslide Mitigation Action Item	**S**	**T**	**A**	**P**	**L**	**E**	**E**	**Final Score**
"High hazard" designation	0	-1	0	-1	0	U	0	-2
Progressive buyout	0	U	U	U	1	U	-1	0
Require notification of renters	-1	U	0	U	0	0	0	-1
Update mapping to include all of CBJ	1	U	U	0	0	U	0	1
Mapping of slopes and soils	1	U	U	0	0	U	0	1
Structural reinforcement of unstable slopes	1	1	0	1	0	U	0	3
Prohibit new construction	1	1	1	U	1	0	0	4

Utilize Gastineau Avenue drainage system	1	1	1	1	U	1	0	5
Prohibit removal of vegetation	1	1	1	0	0	1	1	5
Downtown Fire Mitigation Action Item	**S**	**T**	**A**	**P**	**L**	**E**	**E**	**Final Score**
Mandatory sprinklers in downtown buildings	0	1	0	U	0	U	0	1
Update hazard zone mapping	U	U	1	U	0	U	0	1
Incentives for fire protection measures	0	U	1	0	0	1	0	2
Restrict smoking in downtown area	1	1	1	U	U	0	0	3
Restrict open burning	0	1	U	U	1	1	1	4
Increase/update code enforcement	U	1	1	U	1	1	0	4
Receptacles for cigarette butts	1	1	1	U	0	0	1	4

The prioritized mitigation actions were then were used to create the Mitigation Action Plan.

Mitigation Action Plan

The Mitigation Action Plan refers to the extended effort on the part of the CBJ to address the hazards that threaten the city and its residents. As resources and funding become available, the CBJ will complete the following mitigation activities to protect the city from avalanches, landslides, and fire in downtown Juneau.

During the first public meeting held during the initial development of the plan, residents expressed that their primary concern in regards to hazards was the threat of avalanches to the CBJ. Landslides were a secondary concern, and downtown fire was ranked third. Utilizing these rankings and the evaluations performed by the Planning Team, the Mitigation Action Plan was created to emphasize the mitigation actions that had the most effect on the most significant hazards. Due to deficiencies in data, more information is needed to accurately assess which mitigation options are the most cost effective for the city.

Goal 1: Utilize existing or available methods of hazard mitigation that do not require a significant financial investment by the CBJ.

- *Objective 1.1 – Enact or utilize code changes that reduce hazard risks or prevent an increase in vulnerability:*
    - Prohibit all new construction in avalanche and landslide hazard zones
    - Public education
    - Prohibit removal of vegetation in landslide zones
    - Restrict open burning in the downtown hazard zone area

- *Objective 1.2 – Utilize existing infrastructure designed for hazard mitigation and existing programs that reduce the vulnerability to hazards or promote public awareness of hazards, or allow the CBJ to better prepare for emergency response to hazards.*
    - Ensure that existing Gastineau Avenue drainage system is regularly maintained to reduce the likelihood of landslides in that area.
    - Utilize daily snow avalanche condition reports issued by Eaglecrest Ski Area as a general assessment of avalanche conditions throughout the CBJ.

- *Objective 1.3 – Ensure that current codes and ordinances relating to hazard mitigation are enforced.*
    - Increase fire code enforcement in the downtown fire hazard area.
    - Enforce real estate disclosure laws regarding hazard zones, including disclosure to tenants

Goal 2: Determine the most cost-effective method by which to reduce the avalanche hazard in the CBJ.

- *Objective 2.1 – Enact the mitigation methods which do not require a significant financial investment by the CBJ.*
    - Prohibit all new construction in avalanche zones
    - Public education

- *Objective 2.2 – Assess the actual costs involved in designing, purchasing, and installing structural avalanche control for residential areas in the CBJ.*
    - Conduct an avalanche system design study, performed by a qualified avalanche system design engineer, to establish the specifics of installing such a system in the CBJ.

- *Objective 2.3 – Assess the actual costs of a buyout of residential areas that are vulnerable to the avalanche hazard in the CBJ.*
    - Utilize the assessor’s database to establish the most up to date and accurate information regarding the assessed value of all residential properties in avalanche zones.

Goal 3: Introduce simple, low cost methods that reduce vulnerability to hazards, promote public education of hazards, or have secondary benefits to the CBJ.

- *Objective 3.1: Install cigarette disposal receptacles in the downtown area, especially in places where smokers congregate or where cigarette butts are typically dropped.*

- *Objective 3.2: Install warning signage regarding avalanche, landslide, and downtown fire danger zones.*

Goal 4: Obtain more accurate information regarding hazards to which the CBJ is vulnerable.

- *Objective 4.1: Extend mapping of hazard zones to include all developed areas of the CBJ*
    - Conduct avalanche and landslide studies on areas of the CBJ that are not currently covered in the Mitigation Plan, such as Douglas Island, the Mendenhall Valley, and developed areas along the Glacier Highway.

- *Objective 4.2: Conduct more accurate soil and slope stability studies throughout the CBJ to better determine extent of landslide hazards.*

Goal 5: Promote mitigation measures that can be undertaken by home and business owners.

- *Objective 5.1 – Encourage downtown business owners to install sprinkler systems in their buildings by providing incentives such as tax breaks.*

- *Objective 5.2 – Provide homeowners in avalanche zones with information on how to update existing structures to avalanche impact load standards.*

The Mitigation Plan will be reviewed annually, and the Mitigation Action Plan will be regularly revised as mitigation actions are completed and more information about other hazards is added.

Mitigation Action Implementation

In guiding the implementation of the mitigation actions over the next five years, the CCEPC and the CBJ will focus on changes or modifications to the plan and actions that need to be made based upon:

- changes in goals and hazard conditions;
- accomplishments in implementation;
- changes in the magnitude of risks associated with hazards;
- availability of resources to implement the plan;
- identification of implementation problems, such as technical, financial, political, legal, or institutional capabilities;
- review and assessment of outcomes and results as related to expectations; and
- review of participation of agencies and organizations and related needs and opportunities.

The following table shows how each mitigation action will be implemented by hazard type, its priority, which goal and objective it applies to, who it will be administered by, the resources needed to implement the action, potential funding sources, estimated costs (if known at this time), and the schedule for implementation. In future updates to this plan, actions that apply to multiple hazards will be consolidated.

Table 24 Implementation of Mitigation Actions

Jurisdiction: City and Borough of Juneau											Applicable Hazard											
Mitigation Action/Project	**Priority #**	**Applies to Goal #**	**Applies to Objective #**	**Administered by**	**Resources Needed**	**Funding Source**	**Estimated Cost**	**Schedule**	**Applies to Existing Buildings/Infrastructure**	**Applies to Future Buildings/Infrastructure**	**Avalanche**	**Landslide**	**Downtown Fire**	**Earthquake**	**Severe Weather**	**Air Transportation**	**Floods**	**Volcano**	**Wildland Fire**	**Tsunami**	**Power Grid Failure**	**Public Health Crisis**
Avalanche																						
Prohibit all new construction in hazard zones	1	2	2.1	CBJ	CBJ staff	CBJ	Staff time	1 year		x	x											
Utilize appropriate methods of structural avalanche control (snow fences, diversion/containment structures, reforestation)	2	2	2.2	CBJ (Supported by ADOT&PF)	CBJ & ADOT&PF Staff & funding for design, materials and installation	CBJ, PDMG, EMPG	Avalanche system design, purchase of materials, and cost of installation TBD	1-2 years; permanent when complete although may require light maintenance	x	x	x											
Public Education - Continue to educate regarding avalanche hazard, Promote mitigation plan effort, Encourage homeowners to undertake mitigation actions for their own homes	3	2	2.1	CBJ	CBJ Staff	CBJ, EMPG, PDMG	Staff Time	Ongoing	x	x	x											
Update existing structures to impact loads	4	5	5.2	CBJ	Funding for structure updates	PDMG, TBD	Staff time, consultant time and materials TBD	10-50+ years	X		X											
Establish regular avalanche hazard evaluation and forecasting during the winter months	5	2		CBJ	Funding for CBJ staff or outside consultant	CBJ, LEPC	CBJ annual salary or consultant fee TBD	1 year	x	x	x											
Progressively buy out homes in high hazard zones	6	2	2.3	CBJ	Funding for buy out and staff/administration time	CBJ, HMPG, PDMG	Market value of all homes in high hazard area to be evaluated on a case-by-case basis	10-50+ years	x		x											
Attach "high hazard zone" designation to titles of properties	7	1		CBJ	CBJ staff	CBJ	Staff time	1 year	x		x											

Table 24 Implementation of Mitigation Actions

Jurisdiction: City and Borough of Juneau											Applicable Hazard											
Mitigation Action/Project	Priority #	Applies to Goal #	Applies to Objective #	Administered by	Resources Needed	Funding Source	Estimated Cost	Schedule	Applies to Existing Buildings/Infrastructure	Applies to Future Buildings/Infrastructure	Avalanche	Landslide	Downtown Fire	Earthquake	Severe Weather	Air Transportation	Floods	Volcano	Wildland Fire	Tsunami	Power Grid Failure	Public Health Crisis
Landslide																						
Prohibit removal of vegetation in landslide areas	1	1	1.1	CBJ	CBJ staff	CBJ	Staff time	1 year	x	x		x										
Utilize existing drainage system above Gastineau Avenue	2	1	1.2	CBJ	Staff time to investigation state of drainage systems; future staff time and materials for maintenance	CBJ	Staff time & materials TBD	Immediately - 1 year	x	x		x										
Restrict construction in landslide zones	3	1	1.1	CBJ	CBJ staff	CBJ	Staff time	1 year		x		x										
Structural reinforcement of unstable slopes	4	4	4.2	CBJ (Supported by ADOT&PF)	CBJ & ADOT&PF Staff & funding for design, materials and installation	CBJ, State of Alaska, EMPG, PDMG	Design, materials and installation costs TBD	1-10 years	x	x		x										
Thorough geological mapping of soils and slopes	5	4	4.2	CBJ	CBJ & ADOT&PF Staff & funding for investigation	TBD	Staff time	3-10 years	x	x		x										
Update CBJ mapping to reflect high hazard and moderate hazard areas as determined in CBJ-funded studies	6	4	4.1	CBJ	CBJ GIS staff	CBJ, EMPG, HMGP	Staff time	3-5 years	x	x		x										
Require owners to notify renters of hazard prior to occupancy	7	1	1.3	CBJ	CBJ staff	CBJ	Staff time	1 year	x			x										
Buy out of affected properties	8	2	2.3	CBJ	Funding for buy out and staff/administration time	CBJ, HMPG, PDMG	Market value of all homes in high hazard area to be evaluated on a case-by-case basis	10-50+ years	x			x										
Attach "high hazard zone" designation to titles of properties	9	1		CBJ	CBJ staff	CBJ	Staff time	1 year	x			x										

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Downtown Fire																						
Place cigarette receptacles in strategic location to discourage careless disposal	1	3	3.1	CBJ	CBJ staff	CBJ	Staff time and cost of receptacles, installation and future maintenance	1 year	x				x									
Increase code enforcement	2	1	1.3	CBJ	CBJ staff	CBJ	Staff time	Ongoing	x				x									
Restrict open burning/campfires in hazard area	3	1	1.1	CBJ	CBJ staff	CBJ	Staff time	1 year	x				x									
Restrict smoking in the downtown area	4	1	1.1	CBJ	CBJ Staff for future enforcement	CBJ	Staff time	1 year	x				x									
Provide incentives for business owners to incorporate fire protection measures	5	5	5.1	CBJ	CBJ staff	CBJ, USFA	Staff time & incentives costs TBD	1-3 years	x				x									
Update downtown fire hazard zone mapping to more accurately reflect highest hazard areas	6	4		CBJ	CBJ staff	CBJ, HMGP, USFA	Staff time	1 year	x	x			x									
Code changes: Mandatory sprinklers for structures in hazard zone	7	1	1.1	CBJ	CBJ Staff for future enforcement	CBJ, USFA, HMGP, PDMG	Staff time	1 year	x				x									

Appendix A:
Public Involvement

Comments and questions submitted by plan reviewers and the public were used to develop the plan. Specific comments and questions were addressed within the plan whenever possible. Public opinion obtained during the two public meeting was taken into consideration while prioritizing mitigation actions.

<u>Drafts Reviewed by:</u>

Jan Beauchamp
Tim Bigelow
Bruce Bowler
Peter Carter
Cheryl Easterwood
Richard Etheridge
Chris Maier
Heather Marlow
Gary Mendivil
Mark Miles
Jerry Nankervis
Mike Patterson
Merrill Sanford
Craig Smith
CBJ Engineering Department
CBJ Community Development Department

CAPITAL CITY EMERGENCY PLANNING COMMITTEE

PUBLIC MEETING NOTES
August 6, 2003, 7pm

Members Present: Mark Miles, Chairman; Jerry Nankervis, Richard Etheridge, Merrill Sanford, Jan Beauchamp, Cheryl Easterwood

Staff Present: Jill Missal

Public Present: Marian Mann, Tom Gemmel

The committee met to host a public meeting regarding the CBJ Mitigation Plan. All present discussed and voted on which hazards they felt were most significant. A brainstorming session was also conducted to obtain a list of possible mitigation activities. The results are as follows:

New contributions to list of hazards

- Electrical/communications failure
- Water supply contamination
- Biological - disease
- Update terrorism annex
- Air quality
- Update hazmat annex

Ranked Hazards:

1. Avalanche
2. Urban Fire
3. Mass Transit
4. Earthquake
5. Landslide
6. Disease

Mitigation ideas

Fire

- Mandatory sprinklers for downtown structures
- Increase code enforcement

- List heavy equipment on standby
- Fire boat
- Training
- Voluntary incentives
- Tighter codes
- Evacuation routes

Mass transit

- Readiness
- CDL
- JPD commercial vehicle inspections
- Gated pedestrian areas
- Separate driver/tour guide

Earthquake

- Public education
- Retrofit bridges
- FEMA programs
- ID existing studies
- Codes
- Current programs
- Dam vulnerability
- ID vulnerable areas
- Alternate command center
- Shelters

Landslide

- Causes
- Readiness
- Zoning
- Heavy rain warning
- Public notification/education

Disease

- Public education
- Target cruise ships
- Readiness
- Early ID
- Establish working relationship with cruise lines

CBJ Hazard Mitigation Plan Workshop

June 16, 2004

CBJ Staff Present: Michael Patterson

Facilitator: Jill Missal, URS Corporation

Public present: Chris Maier, Judy and Tom Hall, Gary Helmer, Lisa Anderson, Carroll Holst, Cliff and Betty Cole, Bryan Bell, Autumn Lowrey, Marna and Pat Mc Gonegall, Chris Anderson, Nancy Waterman, Bruce Bowler, Steve Bradford

Participants in the workshop provided the following options and suggestions for CBJ mitigation activities for avalanches, landslides, and downtown Juneau fire.

Avalanche

- Containment ditch at top of subdivisions
- Early warning system
- Cornice removal as it builds up
- “Think tank” w/ engineers as well as avalanche professionals
- Ask for volunteers for system design
- Contest for avalanche system design
- Containment mounds
- Frequent triggering transverse gully- i.e. build a snow fence
- Improve properties to meet current building codes
- Better warning signs

Landslide

- Use Gastineau Avenue drainage system
- Maintain existing catchment basins (227-215 Gastineau)
- Troy St in Behrends Subdivision CBN maintained during last major events (98,99,2000)
- Gastineau Ave. vs. AEL&P; AEL&P removing vegetation from slopes above houses

Fire

- Early warning system
- Consider vacant buildings (winter)
- Private contractors for alarms (LJ alarms)

- Public education of danger
- Concentrate on South Franklin
- Take advantage of road work (underground utilities, add sprinklers, etc)
- Insurance rates/incentives
- Standpipes
- Map hydrant connections
- Ordinance against open flames in buildings
- List hazardous contents in buildings (being done- tier II)
- Fire safety education
- Install “pull” boxes downtown
- Education vs. enforcement
- Who owns/leases
- Traffic control
- Evacuation plan
- Cruise ships
- Fire hydrants on same side as enforced parking (Gastineau/gold)
- Use downtown speaker system (clock bells) for alarm system
- Monitor hazard areas with cameras

Priorities

- Money is relative
- Education vs. engineering building permitting process
- Mitigate severity
- You get what you pay for
- Prioritize by actual risk
- Don’t create more risks

General

- Expand mapping outside downtown Juneau
- Focus on all parts of Borough when mapping/mitigation
- Incorporate climate changes
- Update maps/info regularly
- University studies- can be used for mapping/research

The following is a selection of the written comments and questions that were submitted by workshop participants:

- What algorithm/methodology is used to calculate return cycles on avalanche zones?
- Mitigation plans need to balance the cost to the city with the cost to the individual. Some of the least expensive solutions for the city represent the largest financial impact to the individual – primarily in the form of adverse property value adjustments.
- Would like to know more about hazard definitions and avalanche occurrence calculations.
- Would like to know avalanche frequency occurrence formula for Behrends subdivision.
- All avalanches are reported in this report, no matter how minor…provides a false sense of danger.
- An avalanche is of no concern unless some property damage occurs. What is the frequency of avalanches causing damage in White and Behrends avalanche paths?
- Buyers of existing property are protected by real estate disclosure requirements. No additional CBJ oversight or regulations are required to protect the public.
- Due to the low frequency of avalanche damage to existing buildings in the CBJ, a buyback program for properties located in high hazard areas is not justified. It has been several years since a potential damaging avalanche condition has been present in the White or Behrends paths. The only CBJ action required is to develop an early warning system for when avalanche conditions do develop with sufficient size to potentially damage buildings in these areas.
- If CBJ requires all dwelling in avalanche zones to be listed as high hazard areas, and requires a "high hazard" designation to the title or deed, how will this affect the fair market value (FMV) of said property?
- When does CBJ anticipate they may begin, if at all, any buyout of homes in avalanche paths? How much advance notice will residents be given to relocate?
- If CBJ enacts a buyout of homes in avalanche paths, how will the FMV be determined and by whom, i.e. independent third party v. individual hired with CBJ's best interests in mind. Will this determination of FMV be before the "high hazard" designation or after?
- What percentage of FMV will CBJ provide for those persons holding properties in "high hazard" areas for moving/relocation and/or incidental expenses related to moving/relocation?
- If the FMV of said properties is determined to be lower than the current assessed value after the evaluation and designation as a "high hazard" area, will CBJ automatically lower the assessment (and taxes) on the affected areas?
- How will CBJ enact a buyout of homes in avalanche paths with a budget deficit?
- Refer to CBJ zoning maps, etc. use some terms from these maps in the Mitigation Plan.

- Historic CBJ drainage system above Gastineau Ave. should be rebuilt (controlling mass wasting coming across private property and into street.
- Would underground utilities improve safety from a fire disaster?
- CBJ needs to “Master Plan” in order to accomplish and afford to underground utilities.

Appendix B:

Adoption Resolution

Presented by: The Manager
Introduced: 11/22/2004
Drafted by: J.W. Hartle

RESOLUTION OF THE CITY AND BOROUGH OF JUNEAU, ALASKA

Serial No. 2290

A Resolution Adopting the All-Hazards Mitigation Plan for the City and Borough of Juneau.

WHEREAS, pursuant to 44 CFR Part 201.6, the local mitigation plan is the representation of the jurisdiction's commitment to reduce risks from natural hazards, serving as a guide for decision makers as they commit resources to reducing the effects of natural hazards; and

WHEREAS, for disasters declared on or after November 1, 2004, a local government must have a mitigation plan approved pursuant to 44 CFR Part 201.6(a)(1) in order to receive Hazard Mitigation Grant Program project grants; and

WHEREAS, local mitigation plans will serve as the basis for the State to provide technical assistance and to prioritize project funding; and

WHEREAS, the City and Borough of Juneau All-Hazards Mitigation Plan includes information to assist City and Borough agencies and residents with planning to avoid potential future disaster losses, and provides information on hazards that affect Juneau, descriptions of past disasters, and lists activities that may help the City and Borough prevent disaster losses; and

WHEREAS, the All-Hazards Mitigation Plan was designed and written beginning in Spring 2003 by CBJ Emergency Management staff, with contributions from the Juneau Office of the National Weather Service; State of Alaska Division of Emergency Services (ADES), and overseen by the Capital City Emergency Planning Committee (CCEPC); and

WHEREAS, the City and Borough contracted a hazard mitigation consultant, URS Corporation, to complete the vulnerability assessments for avalanche, landslide, and downtown fire hazards, as well as public meeting facilitation, capability assessments, preparation of prioritization criteria, mitigation prioritization, and cost/benefit analysis; and

WHEREAS, the Capital City Emergency Planning Committee at its November 16, 2004, meeting endorsed the City and Borough of Juneau All-Hazards Mitigation Plan; and

WHEREAS, it is in the best interests of the citizens of Juneau that the City and Borough of Juneau All-Hazards Mitigation Plan be adopted and implemented.

NOW, THEREFORE, BE IT RESOLVED BY THE ASSEMBLY OF THE CITY AND BOROUGH OF JUNEAU, ALASKA:

Section 1. The City and Borough of Juneau All-Hazards Mitigation Plan, dated October 29, 2004, is hereby adopted. Copies of this resolution and plan shall be distributed to the Alaska Division of Emergency Services, and other appropriate agencies.

Section 2. Effective Date. This resolution shall be effective immediately upon adoption.

Adopted this 22nd day of November, 2004.

Bruce Botelho, Mayor

Attest:

Laurie J. Sica, Clerk